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ABSTRACT

In 1983-84, a feasibility study was conducted to determine the viability of establishing a comprehensive alternative energy technology program at Southeastern Illinois College (SIC). The study involved an examination of a number of exemplary associate degree programs in alternative energy, through on-site visits and telephone surveys; a survey of business and industry representatives to determine the current and projected labor market for employees with varying degrees of alternative energy skills and knowledge; and a survey of SIC student interest in enrolling in alternative energy-related workshops, courses, and programs at the college. Selected findings included the following: (1) solar and alternative energy education programs have had a difficult time keeping up with the industry; (2) job market demand for employees with associate degrees in solar technology was not strong; (3) most existing programs were experiencing declining enrollment and recruitment difficulties; (4) although difficult to quantify, there were clearly jobs opening in the alternative energy technology, energy management, and energy conservation areas; (5) the jobs in the energy field were and were projected to be in much more diversified areas than had been predicted a few years previously; and (6) less than half of the students surveyed were interested in one- or two-year degree programs in the field. Based on study findings, it was recommended that the SIC alternative energy program be started as part of an existing program. Questionnaires and program descriptions are included. (LAL)

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A FEASIBILITY STUDY TO ASSESS ALTERNATIVE ENERGY PROGRAM DEVELOPMENT POTENTIAL AT THE COMMUNITY COLLEGE LEVEL

FINAL REPORT

Brittain A. Blair
Project Director
Southeastern Illinois College
Harrisburg, Illinois

October 1, 1983 - June 30, 1984

SC 840 501

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FINAL REPORT

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A FEASIBILITY STUDY TO ASSESS ALTERNATIVE ENERGY PROGRAM DEVELOPMENT POTENTIAL AT THE COMMUNITY COLLEGE LEVEL

Brittain A. Blair, Project Director
Southeastern Illinois College
Harrisburg, Illinois

October 1, 1983 - June 30, 1984

FINAL REPORT ABSTRACT

TITLE: A Feasibility Study to Assess Alternative Energy Program Development Potential at the Community College Level, R-31-14-X-0332-509, October 1, 1983 to June 30, 1984

PRINCIPAL INVESTIGATOR: Brittain A. Blair

INSTITUTION: Southeastern Illinois College

LOCATION: R.R. #4, College Drive, Harrisburg, Illinois 62946

OBJECTIVES:

1. Complete by March 31, 1984 a feasibility study to determine the viability of establishing a comprehensive alternative energy technology program at Southeastern Illinois College.

PROCEDURES:

1. In October 1983, a review of current literature and information on basic, cost-effective alternative energy systems and exemplary vocational training programs involving such systems will be conducted by Project Staff to determine those vocational programs warranting on-site visits and evaluations.

2. From November 1 through November 15, 1983 Project Staff will select a number of exemplary vocational training programs in alternative energy technologies to visit and evaluate.

3. From November 15 through December 31, 1983 Project Staff will visit and evaluate a number of exemplary vocational training programs in alternative energy technologies.

4. From January 1 through February 29, 1984 Project Staff will conduct a community survey to determine public need, demand, and support for an alternative energy training program at Southeastern.

5. In March 1984, Project Staff will draft a feasibility study report based upon Southeastern capacity to implement a diversified vocational program in basic alternative energy technologies.

EXPECTED CONTRIBUTION OR POTENTIAL IMPACT ON VOCATIONAL AND TECHNICAL EDUCATION

The feasibility study proposed here will provide DAVTE, ICCB, and Southeastern Illinois College with the necessary information upon which a decision can be based regarding future funding and development of an alternative energy vocational training program at Southeastern.

PRODUCTS TO BE DELIVERED

Two copies of a progress report will be mailed to DAVTE by December 31, 1983.

Ten copies of a final report will be mailed to DAVTE by March 31, 1984.

Ten copies of a feasibility study report will be mailed to DAVTE by March 31, 1984.

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Illinois State Board of Education

Department of Adult, Vocational and Technical Education
Research and Development Section

Product Abstract

1. Title of material: A Feasibility Study to Assess Alternative Energy Program Development Potential at the Community College Level

2. Date material was completed: July 30, 1984

3. Please check one: New material [x] Revised material [ ]

4. Originating agency: Southeastern Illinois College
   Address: RR #4, College Drive Harrisburg, Illinois Zip Code: 62946

5. Name(s) of developer(s): Brittain Blair, Sam Porter, Jeff Graef
   Address: Southeastern Illinois College, Harrisburg, Illinois Zip Code: 62946

6. Developed pursuant to Contract Number: R-31-14-X-0332-509

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   USOE Code

   - [ ] 01 Agricultural Education
   - [ ] 03 Business and Office Education
   - [ ] 04 Distributive Education
   - [ ] 07 Health Occupations Education
   - [ ] 09 Home Economics Education
   - [ ] 10 Industrial Art Education
   - [x] 16 Technical Education
   - [ ] 17 Trade and Industrial Education
   - [ ] 22 Cooperative Education
   - [ ] Career Education
   - [ ] Other (Specify) _____

8. Education Level:

   - [ ] Pre-K Thru 6
   - [ ] 7-8
   - [ ] 9-10
   - [ ] 11-12
   - [x] Post-Secondary
   - [ ] Adult
   - [ ] Teacher (Pre-service)
   - [ ] Administrator (Pre-Service)
   - [ ] Other (Specify) _____

9. Intended for Use By:

   - [ ] Student
   - [ ] Classroom Teacher
   - [x] Local Administrator
   - [ ] Teacher Educator
   - [ ] Guidance Staff
   - [x] State Personnel
   - [ ] Other (Specify) _____

10. Student Type:

    - [x] Regular
    - [ ] Disadvantaged
    - [ ] Handicapped
    - [ ] Limited English Proficiency
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Department of Adult, Vocational and Technical Education
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Springfield, IL 62777
(217) 782-4620

16. General **Description (State the general objective** and **suggested method** of use. Summarize **the content and tell how it is organized**. Continue on back **of this sheet** or on another **sheet**, if necessary.):

The feasibility study will help determine the viability of establishing a **comprehensive** alternative energy technology program at Southeastern Illinois College. The study will provide DAVTE, ICCB, and Southeastern with the necessary information upon which a decision can be based regarding future funding and development of an alternative **energy** vocational training program at Southeastern.

17. Person Completing this Abstract: Brittain A. Blair, Project Director

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PAID PARTICIPANTS

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   Southeastern Illinois College

2. Sam Porter
   Assistant Project Director
   Southeastern Illinois College

3. Jeff Graef
   Consultant
   Shawnee Solar Development, Inc.

4. Dr. Dennis Dees
   Consultant
   Argonne National Laboratories

RESOURCE LISTING

1. Jobs and Energy published by the National Council on Economic Priorities.

2. Competency-Based Curriculum for Solar Energy Program
   Navarro College, Corsicana, Texas

3. Energy Conservation Curriculum Guide: 2 Volumes
   Occupational Curriculum Lab, East Texas State University

ACCOMPLISHMENTS

1. Completed a feasibility study to determine the viability of establishing a comprehensive alternative energy technology program at Southeastern Illinois College.

2. Received a state award in the Illinois Department of Energy and Natural Resources' "Illinois Conservation and Renewable Energy Awards Program."

STATEMENT OF IMPACT

The feasibility study will provide DAVTE, ICCB, and Southeastern Illinois College with the necessary information upon which a decision can be based regarding future funding and development of an alternative energy vocational training program at the community college level.

Illinois Department of
Energy and Natural Resources

325 W. Adams, Room 300
Springfield, Illinois 62708
217/785-2800

August 1, 1984

Mr. Brittain Blair
Southeastern Illinois College
Route 4, College Drive
Harrisburg, IL 62946

Dear Mr. Blair:

Thank you for your application to the Illinois Conservation and Renewable Energy Awards Program and Technology Transfer '80's. I am pleased to inform you that your project has been chosen as a recipient of a State award. A certificate is being prepared and will be sent to you shortly.

Although your project was an excellent one, it was not among those selected for inclusion in the federal competition. Many exceptional projects were received and unfortunately the State was limited to ten nominees for federal awards.

I congratulate you on your State award and applaud your dedication to energy-efficiency.

Sincerely,

Michael B. Witte

Michael B. Witte
Director

A FEASIBILITY STUDY TO ASSESS ALTERNATIVE ENERGY PROGRAM DEVELOPMENT POTENTIAL AT THE COMMUNITY COLLEGE LEVEL

A FINAL REPORT
COMPILED FOR THE
ILLINOIS STATE BOARD OF EDUCATION
DEPARTMENT OF ADULT, VOCATIONAL AND TECHNICAL EDUCATION

Brittain A. Blair, Project Director
Sam Porter, Principal Investigator
Jeff Graef, Technical and Curriculum Consultant

Southeastern Illinois College
Harrisburg, Illinois

July 30, 1984

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INTRODUCTION

Since 1979, Southeastern Illinois College has been involved in a variety of research and development activities designed to bring the United States closer to energy self-sufficiency using renewable resources. With its state of the art anhydrous alcohol fuels production and co-product utilization facilities and the work of Dr. Richard Blaser in internal combustion engine conversion technology, Southeastern has been heralded as one of the nation's leaders among educational institutions on the cutting edge of alternative energy-related activities. Furthermore, the college was among the first to develop a competency-based vocational curriculum designed to establish educational standards in the technologies of alcohol fuels production and utilization.

"A Feasibility Study to Assess Alternative Energy Program Development Potential at the Community College Level" is yet another step towards attaining energy self-suffiency in this country and the realization of an energy park concept that would establish Southeastern Illinois College as a vocational training and curriculum development center for alternative energy studies. In conducting the study, staff members found that a network of communication and cooperation with other colleges once again played a crucial role in successfully completing project objectives and goals. A special note of appreciation goes out to Christopher Benson of Mississippi County Community College; Carl Kuhnle and Don Pearson of Texas State Technical Institute; Charles Orsak of Navarro College; Clarence Tresler of Central Texas College; and Conrad Heins, Niels Anderson, and James

Mackenzie of Jordan College Energy Institute for arranging tours, providing detailed information, and offering invaluable advice from the perspective of experience. Without the assistance of these gentlemen and the colleges they represent, this most important study would not have been possible.

Others who gave generously of their time and shared a wealth of experience include Terry Egnor, Edmunds Community College, Lynwood, Washington; Johnny Weiss, Colorado Mountain College, Glenwood Springs, Colorado; Jeff Cole, the Sun Company, Seattle, Washington; Bob Koester, Ball State, Muncie, Indiana; Dr. David LaHart, Florida Solar Energy Center, Cape Canaveral, Florida; Leary O'Gorman, Colorado Technical College, Colorado Springs, Colorado; Pat Enz, Red Wing Area Vocational Technical Institute, Red Wing, Minnesota; Francis Dunning, Mohawk Valley Community College, Utica, New York; Betsy Densmore, Center for Neighborhood Technology, Chicago, Illinois; Gary Mielke, Illinois Department of Energy and Natural Resources, Chicago, Illinois; and Norman Abell, Brevard Community College; Cocoa, Florida.

PROBLEM STATEMENT

As conventional energy costs and asscciated pollution levels continue to increase, so does the energy consumer's attempt to find and implement workable, efficient, and environmentally safe alternative energy methods. It is because of such an emerging energy-awareness movement, both on a residential and commercial scale, that Southeastern Illinois College and the Illinois Department of Adult, Vocational and Technical Education feel the growing responsibility to expand their treatment of alternative energy technologies and to work towards an energy park concept by offering seminars, workshops, and credit-bearing courses within the framework of a comprehensive alternative energy vocational education program. Such a program would train the layperson, the energy-conscious professional seeking retraining, and the career-oriented student to design, construct, install, operate, maintain, troubleshoot, and repair basic and sophisticated alternative energy systems. Too, students would study energy economics and energy conservation as integral parts of the overall alternative energies discipline.

However, before a program of this type and magnitude can be initiated, a feasibility study based on current labor market data and a close comparative examination of a number of established exemplary alternative energy vocational programs must be conducted to determine (1.) if labor market demands for alternative energy technicians and retrained professionals warrant such a program, (2.) if Southeastern has the capacity and resources to offer the program, and (3.) if such a program could sustain itself

through student enrollment. The study that follows provides answers to these questions and supplies Southeastern, DAVTE, and ICCB with reliable information from which decisions can be made regarding levels of future funding and development of an alternative energy vocational training program at Southeastern.

PROJECT DESCRIPTION

To receive a better understanding of what was involved in establishing an alternative energies vocational program at the college level, it was imperative to examine a number of exemplary A.A.S. degree programs designed accordingly. To determine tne quality of existing alternative energy programs in the United States and to select the ones warranting on-site visits, project staff referred to three major sources: Energy-Related Activities in Community, Junior and Technical Colleges: A Directory compiled and published by the American Association of Community and Junior Colleges; Current Alternative Energy Research and Development in Illinois compiled and published by the Illinois Department of Energy and Natural Resources; and the National Solar Energy Education Directory compiled and published by the U.S. Department of Energy.

Once programs were selected for on-site visits and itineraries were confirmed, an evaluation tool was developed to collect and compare information regarding each program. During on-site visits, project staff employed the evaluation tool, observed classroom and laboratory activities, and engaged in discussions with program personnel. To provide a wider cross section of programs to evaluate, project staff conducted a telephone survey of a number of programs that were determined exemplary but were impossible to visit given the budget limitations of the project.

Jobs and Energy, a report published by the Council of Economic Priorities, and a needs assessment survey sent to Illinois business and industry were the two instruments used to collect labor market

data from which the current and projected employability of alternative energy technicians was determined.

Based on the information gathered through these procedures, the feasibility study provides the reader with objective findings, a labor market needs assessment, and overall conclusions and recommendations pertaining to alternative energy program development potential at the community college level.

Campus and Institute Descriptions

Jordan College - Cedar Springs Campus

The Cedar Springs Campus is the site of the original campus of Jordan College and continues to house the corporate offices. It is located about 20 miles north of Grand Rapids at the edge of the rural City of Cedar Springs. Many renewable energy installations contribute to the energy needs of the buildings, and groups often come to tour them.

The Campus enrolls students who have a Christian commitment and a desire to take full advantage of the living and learning experiences provided. Students are also able to participate in travel study to England, France and Israel. In addition to the day program, an evening college is open to residents of the community. This program appeals especially to those who want to study close to home and do not want to drive to Grand Rapids for their classes.

The Cedar Campus is the only one at which dormitories are provided for resident living.

Jordan College - Flint

Jordan College - Flint is a two-year college program designed to serve urban students. This campus uses existing public and private school facilities located within the communities served.

Similar in concept to the Newaygo County Campus, the Flint Campus started serving students of the northern Flint area. The proximity of leased facilities to their homes enables students to pursue low cost higher education without undergoing major psychological, social, and financial adjustments required of students who attend more distant colleges.

Philosophy of the College

The purpose of Jordan College is to develop, through education, all aspects of human character; intellectual, physical, emotional, and spiritual. To this end, we seek to foster an intellectual atmosphere of honest inquiry and to develop an awareness of man's relationship and responsibility to himself and to his environment. The College dedicates itself to providing the skills necessary for effective participation in a world of limited resources and enormous human need. Jordan College has chosen the multi-campus approach to higher education by providing community-based education services to respond to the cultural and technological needs of society where they exist; whether in a rural or an urban setting.

Goals of the College

- To provide post-secondary education programs of the highest quality leading to associate and bachelor degrees in liberal arts, the applied sciences, and technology.
- To foster the development of or to strengthen existing specialized educational centers which would ultimately evolve institutes unique to the cultural, geographic, and technical needs of their various locations.
- To review and revise those programs to meet the changing needs of our complex society, and the educational needs unique to the rural and urban population served by those programs.
- To provide facilities conducive to personal growth, a faculty committed to academic excellence, and support services necessary for the academic, financial, social, personal, and career needs of all students.
- To nurture self-knowledge, breadth of knowledge, intellectual integrity, creativity in all students; to provide the academic and social skills necessary for each student to evolve and express those qualities.

History of the College

Often historians omit the inspiration that may have been the genesis of an organization. The history of Jordan College began with a dream of the Reverend E. D. Coxon, father of Co-President DeWayne Coxon, some twelve years before the organization was actually begun.

At the time, the Reverend Coxon was a minister in Grand Rapids. His love for higher education began during his years as a college student. In later years, he served as a member of the Board of Trustees of his alma mater. It was his dream to establish a Christian College somewhere in Western Michigan.

During the summer of 1966, others acted on the inspiration of the Reverend Coxon and a modest education program was begun in Cedar Springs, Michigan. The name, Wesleyan Bible Institute, was chosen for the college. From 1966 through 1972, much of the financial and organizational burden was carried by the Reverend Coxon in his capacity as Chairman of the Board of Trustees.

During the infancy of the school, dedicated people gave generous amounts of time and money. Through those efforts in 1968, the Institute built its first building: a dining commons, library, and classroom complex. The faculty and staff assisted in the building of the physical plant while working to strengthen the academic programs. Wesleyan Bible Institute began by offering two years of basic, introductory liberal arts courses combined with a three-year Bible curriculum.

In 1969, the University of Michigan accepted a graduate of the Institute. By 1970, the Institute was listed in Report of Credit Given by Educational Institutions, a publication of the American Association of Collegiate Registrars and Admissions Officers. Such a listing allowed for a national transfer of credit on a provisional basis.

During the early years, the Institute received recognition from the Veterans Administration and the U.S. Department of Immigration. This led to a review, in 1972, of academic programs offered by the Institute. A state offical recommended to the Board of Trustees that the school seek collegiate status in order to grant degrees.

The administration was providentially led to a Roman Catholic group, the Society of Divine Savior, located in Milwaukee, Wisconsin. They owned the charter of "Jordan College" which had been located in Menominee, Michigan, and which had been defunct since 1962. The charter was graciously given to the Board of Trustees of the Institute. Thereupon, Wesleyan Bible Institute was transformed into Jordan College at Cedar Springs.

The first fifteen years of the history of Jordan College closed with four important events. (1) Jordan College became a new, non-sectarian, independent college in April 1977 after ownership of the College was transferred to an independent board of trustees. (2) The Association of Independent Colleges and Universities in Michigan (AICUM) invited Jordan College to become a member, thereby increasing the strength of the College. (3) A number of area colleges (Calvin, Ferris, Grand Valley, and Spring Arbor) established new policies granting Jordan College unconditional status regarding the transfer of credit. (4) The College was awarded a grant for $98,000 from ERDA (Energy Research and Development Administration) in Washington, D.C. for its second solar installation. A second grant of $98,000 was given to the College in 1980 for solar research.

Since 1976 the College has expanded to serve over 1,450 students through 6 campuses and learning centers in Michigan. During this time Jordan College has also received international recognition for its pioneering work in renewable energy technologies. Various credit and non-credit renewable energy learning opportunities keep the College in the forefront of the important field of study.

Looking to continued growth in coming years, the College has applied for accreditation with the North Central Association of Colleges and Schools.

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A Brief History

Jordan College is a private college begun in 1967 to provide educational opportunities to both traditional students and those students not served by existing institutions of higher learning. Students with potential to compete at a college level but lacking cultural and social advantages follow training programs at Jordan College leading to associate or bachelor degrees. The two and four year degree programs are offered through four campuses and learning centers. The campuses and learning centers are located throughout Michigan and are built around serving the unique educational needs of the community.

The Jordan College Energy Institute is one such campus located in the greater Grand Rapids area. Unique in its practical application of renewable energy technology, concentrated courses lead to three complete degree programs and careers in Renewable Energy. Students come from across the U.S. and several foreign countries.

Opened in 1974, the Energy Institute is a direct response to increasing awareness of the nation's growing energy problems. The five acre campus with classrooms, labs and library plus a nearly completed 6,000 square foot energy efficient Technical Center provides an excellent "Hands-On" approach for students. The new facility will contain additional classrooms and shop area and will be a model renewable energy research demonstration site.

The Energy Institute trains students to become experts in energy conservation and renewable energy technology. As traditional fossil fuel resources are depleted, demand for graduates continues to increase.

Career Opportunities

Graduating students have applied their learned skills in a variety of career areas — including energy management with school systems as well as with auditors in energy audits of existing systems. These have led to energy and cost savings for both private and industrial applications. Some graduating students have applied their talents to writing and teaching in the area of energy conservation while others have gone on to further educational programs in engineering and architecture.

The Institute has an Office of Career Planning and Placement available to students and alumni. Services include Career/Life Planning Counseling, Credentialing, Resume Preparation Assistance, Current Job Listings, Internship Placement and a Career Library.

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A Brief History: JEI in Western Michigan

The Jordan Energy Institute is located in the heart of West Michigan in the Greater Grand Rapids area. Greater Grand Rapids is Michigan's largest metropolitan area outside of Detroit. It has an outstanding community action achievement record and effective citizen organizations.

Founded in 1826, Grand Rapids offers numerous parks and the joys of country living. A few minutes drive and the metro area drops away to rolling hills, mountainous dunes with sandy shorelines and wooded acres. Hiking, swimming, boating, camping and bike riding are among the wealth of outdoor sports and activities easily enjoyed without extensive pre-planning and hours of driving.

The city, home of several international corporations and many independent companies, offers work opportunities to many. A good work ethic atmosphere exists in the area.

Culturally there are theaters, symphony, ballet, opera and a variety of splendid pop, rock, jazz country and "whatever" concerts.

JEI is the renewable energy branch of Jordan College, a private college, which was founded in 1967 to provide educational opportunities for both traditional students and those students not served by existing institutions of higher learning.

International Program

An Energy Tour to Israel in 1980 inaugurated what is now the Jordan Educational Travel Services. The success of that tour, attended by 75 registrants, led to tours to England, France, the Caribbean, Hawaii, Australia, and Japan.

In 1983 JETS took the largest single contingent to the World Solar Congress in Perth, Australia.

The energy tours gave birth to the Energy Institute's Semesters Abroad which took its first students to England in the fall of 1982. The program enrolled a dozen JEI students who spent their 1983 fall semester in France and another group of JEI students will study energy in Israel in the spring semester of 1985.

An Energy Institute, patterned on JEI, is on the drawing boards for Egypt. A housing complex (Moshav) is planned for construction in Israel under the auspices of Jordan College.

Community Energy Service

The Jordan Energy Institute began as a Community Energy Service program in the form of a solar seminar. These early seminars, in 1976, led directly to the establishment of the Jordan Energy Institute. Since 1976 Jordan has conducted many one- and two-day renewable energy seminars across the United States and participated in a series of Energy Expos inside and outside of Michigan.

An Energy Telephone Hot Line has grown out of the steady stream of requests JEI receives from business people and home owners. The service supplies energy information or directs the inquirers to sources of information.

THREE renewable energy installations can be seen on the Jordan Student Lounge: on the roof is seen part of the 2000 sq. ft. solar water drain down system that heats the building; below is the greenhouse used for appropriate technology experiments and for supplemental heat for the lounge; at the far right is a thermo-syphoning air panel which supplies heat to the lounge.

The Jordan Energy Institute

Jordan College's renewable energy involvement has deepened and matured over the past several years. It has been the College's goal to consolidate academic, international and community energy services at one location. That step was taken in 1983.

The "Jordan Energy Group" has been given the new designation of Jordan Energy Institute. Originally the term "Jordan Energy Institute" referred only to the energy academic facility located at 155 Seven Mile Road, Comstock Park, Michigan. That academic function is now one of the three important components of the enlarged concept of the "Jordan Energy Institute."

The Jordan Energy Institute in its new, more encompassing meaning, is committed towards a positive transformation in all areas of life. The Institute is a non-profit, tax exempt part of Jordan College and is supported by tuition, program revenues, charitable donations from individuals, private foundations and businesses as well as from federal grants.

Through the years the Energy Institute (formerly Energy Group) has played a large part in energy education for individuals interested in alternatives to fossil fuel consumption. The midwest of the United States has felt the impact of the Jordan Energy Institute. Many renewable energy systems are now in operation which were installed by former students of the program.

The programs have grown from the initial "Here Comes the Sun" two-day solar seminar to the development of two-year associate and four-year bachelor degree programs in renewable energy, and into international energy tours and national conferences on energy related issues.

The Cedar Springs Campus continues to maintain renewable energy installations and sponsors two- and four-year Appropriate Technology degrees.

It has been through student involvement and the support of individuals, foundations and governments that the success of the program can be measured. Non-academic participation is taking many forms — from volunteer committees to strong co-sponsorships. Each is recognized as an important expression of participation and commitment.

Purpose:
Jordan Energy Institute recognizes that there is a need to provide energy education and information to people throughout our world. The way by which man uses the natural resources of this world will have a direct bearing on the availability of energy for generations to come. The Energy Institute is dedicated to manifesting the balanced perspective between present energy consumption and alternatives to that consumption.

Goals:
1. To serve persons with educational needs through college-level degree programs and through seminars in renewable energy and appropriate technology.
2. To develop a national energy information program in cooperation with organizations of similar purpose.
3. To maintain international travel programs for students and other persons desiring exposure to and information about other countries that are extensively utilizing renewable forms of energy.
4. To maintain an energy conference center on the Cedar Springs Campus that will be sensitive to the natural environment and to demonstrate models of energy systems that reduce fossil fuel dependence.
5. To conduct renewable energy research and to install renewable energy test systems.
6. To develop and market, through commercial channels, energy devices designed to meet the renewable energy needs of home owners and others.
7. To work with foreign governments on the establishment of Energy Institutes in their countries patterned after the Jordan Energy Institute.

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Energy Management

One of the fastest growing fields in the renewable energy/conservation field, the Energy Management technology is being employed at an ever-increasing rate in business, industry and government installations.

Certificate in Energy Management

This one-year program is a stepping stone to further academic achievement in this field.

Program Objectives

1. To develop a strong technical understanding of energy management in all its basic aspects.
2. To instill a basic understanding of the impact energy management has on private industry profitability and government taxation requirements.
3. To offer laboratory and field experiences in energy management applications.

Certificate Requirements and Course Sequence
The One-Year Energy Management Certificate is granted upon completion of 33 hours with a grade point average of 2.00 or better.

Associate of Applied Science Degree in Renewable Energy

A two-year program designed to provide students with both theoretical and practical knowledge involving the design, operation and installation of renewable energy systems.

Program Objectives

1. To instill an understanding of energy conservation methods and man's impact on the earth's eco-system.
2. To provide practical experience with renewable energy systems, equipment and operation.
3. To develop basic technical skills needed to design and install renewable energy systems.

Degree Requirements and Course Sequence
The Associate of Applied Science Degree in Renewable Energy Technology is conferred upon completion of a minimum of 60 semester hours with a grade point of 2.00 or better. A minimum of 15 credits must be earned at Jordan College.

Bachelor of Science in Renewable Energy Engineering Technology

The engineering technology program offers an in-depth training in the renewable energy field. Analysis and design are combined with hands-on applications to provide students with the skills to design appropriate, cost-effective, renewable energy systems. Activities range from using a computer to size a solar array to assembling collectors, to working as an intern on a renewable energy project.

Program Objectives

1. To develop a strong technical understanding of conventional and renewable energy sources.
2. To instill an understanding of energy management and resource recovery.
3. To provide interdisciplinary examinations of technology from a humanities and social science perspective.

Degree Requirements and Course Sequence
The Bachelor Degree in Renewable Energy Engineering Technology is conferred upon completion of a minimum of 120 hours with a grade point of 2.00 or better. A minimum of 30 credits must be earned at Jordan College. 18 semester hours must be taken at the 300 or 400 levels.

More academic information can be obtained by asking for "Catalog Insert for Energy courses & fees."

Renewable Energy Engineering Technology

Bachelor of Science in Renewable Energy Engineering Technology

Program Objectives

- To instill an understanding of energy conservation methods and man's impact on the earth's ecosystem.
- To provide practical experience with renewable energy systems, equipment, and operation.
- To develop basic technical skills needed to design and install renewable energy systems.

Degree Requirements

The Bachelor of Science Degree in Renewable Energy Engineering Technology is conferred upon completing a minimum of 128 semester hours with a grade point average of 2.00 or better. A minimum of 30 credits must be earned at Jordan College. Eighteen semester hours must be taken at the 300 or 400 levels.

Course		Semester Hours
BY 140	Man's Impact on Environment	3
CI 100	Introduction to Computer Programming	3
EN 101	English Composition I	3
EN 160	Technical Writing	3
MA 111	Algebra I	3
MA 112	Algebra II	3
MA 211	Calculus I	4
MA 212	Calculus II	4
PH 210	General Physics I	4
PH 211	General Physics II	4
RE 100	Introduction to Renewable Energy	3
RE 140	Energy Conservation	3
RE 160	Control Systems	4
RE 199	Introduction to Renewable Energy Lab	1
RE 200	Solar I	3
RE 210	Wind I	3
RE 230	Geophysical Energies	2
RE 240	Biomass I	3
RE 270	Systems Design I	3
RE 275	Weather Analysis	3
RE 277	Residential Energy Audits	3
RE 299	Renewable Energy Core Lab	2
RE 300	Solar II	3
RE 310	Wind II	3
RE 340	Biomass II	3
RE 370	Systems Design II	3
RE 477	Industrial Energy Audits	3
RE 497	**Internship	3
RE 499	Senior Lab Project	3
TC 108	HVAC	3
TC 109	Basic Electricity	3
TC 110	Basic Electricity Lab	1
TC 120	Drafting	3
TC 150	Construction Materials	3
TC 350	Fluid Mechanics	3
TC 360	Strength of Materials	3
	*Electives	21
	TOTAL	128

*These electives are to be used to fulfill Liberal Arts Distributional Requirements for Bachelor of Science.

**An internship is required in either one of 3 semesters. Internship contract and application must be submitted by corporate due date.

Course Descriptions

RE 275 Weather Analysis
An analysis of weather conditions and their effects on solar and wind availability. Topics include cleanness factors, ambient temperature, and wind velocity. Prerequisite: PH 210.

RE 277 Residential Energy Audits
A practical course on energy audits for residential and commercial buildings. Topics include measuring and estimating energy use, and energy codes and laws.

RE 299 Renewable Energy Core Lab
This course is designed to accompany RE 200, RE 210, and RE 240. It is integrated with the supplements, ideas, and concepts learned in these courses. It provides hands-on experience with existing renewable energy systems, and fosters basic skills such as sweating fittings and installing sensors, that are needed to install such systems. It consists of three sessions each of laboratory work in solar, wind, and biomass, followed by a field project in one of these areas.

RE 300 Solar II
A course on passive solar heating and passive design. Topics include basic theories, thermosiphons, greenhouses, trombe walls, direct gain windows, and passive controls. Prerequisite: RE 100, MA 112.

RE 340 Biomass II
Further studies in the availability and use of biomass energy. Includes topics of fermentation, alcohol production, biogas equipment, and utilization of bio-fuels for domestic use and power production. Prerequisite: RE 240.

RE 370 Systems Design II
A course covering photovoltaic and concentrating solar energy systems. Emphasis is on home, small utility, and industrial systems. Prerequisite: MA 211, RE 270.

RE 477 Industrial Energy Audits
This course will introduce the student to the fundamental concepts of Energy Conservation and Management as applied to existing buildings and industrial facilities. Specific areas within energy conservation that will be investigated include: Energy Profiles, Heating, Cooling, HVAC distribution, Domestic Hot Water, Heat Reclamation, Lighting, Power, Central Control Systems and Economic Analysis of Energy Conservation Opportunities. Prerequisite: RE 277.

RE 499 Senior Laboratory Project
Students conduct an independent laboratory project on a subject of their choice. The study involves a literature search, project planning, laboratory work, and a final report. Division Head approval required or senior standing.

TC 150 Construction Materials
An introduction to th emany and varied construction materials, new and old.

(Partial Listing)

Renewable Energy

Bachelor of Science Degree in Renewable Energy

A four-year program designed to serve the needs of students desiring positions in government or industry, this curriculum provides more advanced knowledge and experience with a social and economic base broader than that provided in the Associate of Applied Science Degree.

Program Objectives

- To develop a strong technical base in conventional and renewable energy sources.
- To offer field experience in alternate energy systems installation and operation.
- To provide a background within which technical decisions can be framed.
- To instill a basic understanding of the ecological impact of governmental and industrial energy decisions.

Students in the Bachelor Degree program pursue a more rigorous mathematics and physics curriculum than the Associate Degree program.

Degree Requirements

The Bachelor of Science Degree in Renewable Energy is conferred upon completion of a minimum of 127 semester hours with a grade point average of 2.00 or better. A minimum of 30 credits must be earned at Jordan College. Eighteen (18) semester hours must be taken at the 300 or 400 levels.

Course		Semester Hours
BY 140	Man's Impact on the Environment	3
EN 101	English Composition I	3
EN 160	Technical Writing	3
MA 111	Algebra I	3
MA 112	Algebra II	3
MA 211	Calculus I	4
PH 210	General Physics I	4
PH 211	General Physics II	4
RE 100	Introduction to Renewable Energy	3
RE 140	Energy Conservation	3
RE 160	Control Systems	4
RE 199	Introduction to Renewable Energy Lab	1
RE 200	Solar I	3
RE 210	Wind I	3
RE 230	Geophysical Energies	2
RE 240	Biomass I	3
RE 270	Systems Design I	3
RE 275	Weather Analysis	3
RE 277	Residential Energy Audits	3
RE 299	Renewable Energy Core Lab	2
RE 300	Solar II	3
RE 310	Wind II	3
RE 340	Biomass I	3
RE 370	Systems Design II	3
RE 499	Senior Laboratory Project	3
TC 108	HVAC	3
TC 109	Basic Electricity	3
TC 110	Basic Electricity Lab	1
TC 120	Drafting	3
TC 150	Construction Materials	3
TC 350	Fluid Mechanics	3
TC 360	Strength of Materials	3
	*Electives	33
	TOTAL	127

*These electives are to be used to fulfill Liberal Arts Distributional Requirements for Bachelor of Science degree.

Course Descriptions

RE 100 Introduction to Renewable Energy
Fundamental concepts of solar, wind, biomass, and geophysical energies.

RE 140 Energy Conservation
Theories and applications of energy conservation.

RE 160 Control Systems (3-2)
A theoretical and practical course on control systems. Topics include components selection, installation, troubleshooting, schematics, and control logic. Lab. Prerequisite: TC 109, TC 110, MA 111.

RE 199 Introduction to Renewable Energy Lab
An introduction to the study and application of renewable energy using firsthand observation and experimentation. Students will familiarize themselves with basic methods of gathering renewable energy data. There will be additional work in building simple renewable energy units and calculating energy savings.

RE 200 Solar I
Theories and applications of solar energy. Topics include practical solar availability, collector designs, and efficiencies, heat transfer and storage, controls, and economic considerations. Prerequisite: RE 100, MA 111.

RE 210 Wind I
Theories and application of wind energy. Topics include wind energy, availability, rotor designs, generators, power conversion equipment and wind electric systems. Prerequisite: RE 100, MA 111.

RE 230 Geophysical Energies

Survey of the earth's renewable energy sources other than solar, wind, and biomass. Topics include hydro, ocean, and geothermal energies. Prerequisite: RE 100, MA 111.

RE 240 Biomass I
Availability and applications of biomass energy. Topics include methane digestion, wood burning, technology, and alcohol production. Prerequisite: RE 100, PH 101, MA 111.

RE 270 Systems Design I
A basic course in the design of components for alternate energy systems. Topics include energy storage, collection, conversion, and transmission equipment. Prerequisite: RE 100. Recommended: TC 120, MA 111.

(Partial Listing)

Renewable Energy

Associate of Applied Science Degree in Renewable Energy

This program is a four-semester schedule designed to provide students the background and experience needed to enter the renewable energy job market as installers and designers.

Program Objectives

- To instill an understanding of energy conservation methods and man's impact on the earth's ecosystem.
- To provide practical experience on renewable energy systems, equipment, and operation.
- To develop basic engineering skills needed to design and install renewable energy systems.
- To improve the students' needed skills in Mathematics and Physics.
- To refine communication skills.

Degree Requirements

The Associate of Applied Science Degree in Renewable Energy is conferred upon completion of a minimum of sixty-four (64) semester hours with a grade point average of 2.00 or better. A minimum of 15 credits must be earned at Jordan College.

Jordan College

Course		Semester Hours
BY 140	Man's Impact on the Environment	3
EN 101	English Composition I	3
MA 111	Algebra I	3
PH 101	Physical Science I	3
PH 102	Physical Science II	3
RE 100	Introduction to Renewable Energy	3
RE 140	Energy Conservation	3
RE 160	Control Systems	1
RE 199	Introduction to Renewable Energy Lab	4
RE 200	Solar I	3
RE 210	Wind I	3
RE 230	Geophysical Energies	2
RE 240	Biomass I	3
RE 270	Systems Designs I	3
RE 277	Residential Energy Audits	3
RE 299	Renewable Energy Core Lab	2
TC 108	HVAC	3
TC 109	Basic Electricity	3
TC 110	Basic Electricity Lab	1
TC 120	Drafting	3
TC 150	Construction Materials	3
	Electives	6
	TOTAL	64

Course Descriptions

RE 100 Introduction to Renewable Energy
Fundamental concepts of solar, wind, biomass, and geophysical energies.

RE 140 Energy Conservation
Theories and applications of energy conservation.

RE 160 Control Systems (3-2)
A theoretical and practical course on control systems. Topics include components selection, installation, troubleshooting, schematics, and control logic. Lab. Prerequisite: TC 109, TC 110, MA 111.

RE 199 Introduction to Renewable Energy Lab
An introduction to the study and application of renewable energy using first hand observation and experimentation. Students will familiarize themselves with basic methods of gathering renewable energy data. There will be additional work in building simple renewable energy units and calculating energy savings.

RE 200 Solar I
Theories and applications of solar energy. Topics include practical solar availability, collector design, and efficiencies, heat transfer and storage, controls, and economic considerations. Prerequisite: RE 100, MA 111.

RE 210 Wind I
Theories and applications of wind energy. Topics include wind energy, availability, rotor designs, generators, power conversion equipment and wind electric systems. Prerequisite: RE 100, MA 111.

RE 230 Geophysical Energies
A survey of the earth's renewable energy sources other than solar, wind, and biomass. Topics include hydro, ocean, and geothermal energies. Prerequisite: RE 100, MA 111.

RE 240 Biomass I
Availability and applications of biomass energy. Topics include methane digestion, wood burning technology, and alcohol production. Prerequisite: RE 100, PH 101, MA 111.

RE 270 Systems Design I
A basic course in the design of components for alternate energy systems. Topics include energy storage, collection, conversion, and transmission equipment. Prerequisite: RE 100. Recommended: TC 120, MA 111.

RE 275 Weather Analysis
An analysis of weather conditions and their effects on solar and wind availability. Topics include clearness factors, ambient temperatures, and wind velocity. Prerequisite: PH 210.

RE 277 Residential Energy Audits
A practical course on energy audits for residential and commercial buildings. Topics include measuring and estimating energy use, and energy codes and laws.
(Partial Listing)

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The Practical Side of JEI's Program

Hands-On

Hands-on training reinforces the basic theory learned in the classroom. At Jordan Energy Institute the opportunities for hands-on applications are provided through:

- Core labs
- Workshops
- Field trips
- Internships with area businesses and municipalities
- Preparation and participation in area Energy Expos

Renewable Energy Installations

Jordan College has the largest number of operating renewable energy installations available for study and testing of any similar institution.

At JEI:

Active solar air heating
Passive solar sun space
Passive solar window wall
Trombe wall
Wind generator
Biomass methane gas generator

Cedar Springs Campus:

Active solar hot air heating
Active solar domestic hot water
Greenhouse
Thermosyphoning air panels (2)
Active drain down solar water system
Wood fired boiler
Ground mounted active solar water heating drain back system
Concentrating collector system
Photovoltaic tracking unit
Wind generator

Internships

Internships for our seniors are an important part of their education.

Personal contacts with many area businesses including architects, builders, developers, and energy auditors plus contacts with two cities and a county department, have given us a wide variety of intern opportunities for our students.

Students put their classroom skills to practice in the world of work. Some of the Interns are hired by the businesses upon graduation.

Among the work experiences our Interns are exposed to are:

Energy management
Conservation
Sales
Drafting
Energy Audits
Construction
Internal heat loss analysis
Assessing heat efficiency of existing buildings
Weatherization
Design
Resource research
Writing for Energy Journal
Solar installations
Energy monitoring
Inventory control
Post energy audit surveys

JOBS are the goal:

Ninety-two percent of JEI graduates are in the renewable energy field. The placement rate for our graduates is high because of the growth factor of the renewable energy field.

Recent news reports predict nearly 600,000 new jobs in the areas of Energy Conservation Technician and Energy Auditors jobs by the year 2000.

Our graduates have taken positions in the renewable energy field in:

Recycling
Own businesses
Consultant
Sales
Installations
Energy auditing
Energy auditing management
Project manager
Energy management
Lab technician
Engineering technician

Renewable energy is a very diverse field and the number of technologies related to this field is constantly expanding.

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GENERAL INFORMATION

HISTORY

On December 17, 1974, the voters of Mississippi County approved the establishment of a community college district and the levying of a three mill tax to finance construction of the new community college campus. The State Board of Higher Education and the State Legislature had previously approved establishment of the institution.

Governor Dale Bumpers appointed a nine member Board of Trustees who began a search for a President for the institution. Dr. Harry V. Smith was named President of Mississippi County Community College on February 17, 1975, and began duties in March of 1975. An administrative team and faculty were assembled and on August 25, 1975, classes began for the first time in renovated temporary facilities located in the former Sudbury Elementary School at 200 South Lake Street in Blytheville. Approximately eight hundred (800) students enrolled for credit the first term. Non-credit community service courses began with an additional five hundred (500) students in the spring term.

In February, 1976, the Board of Trustees purchased eighty (80) acres of land for construction of the campus on South Highway 61.

On April 29, 1977, United States Vice President Walter F. Mondale announced that the college had been awarded a $6.3 million federal grant to build the nation's first educational facility powered by solar photovoltaics. An additional $500,000 has been received and combined with the $6.3 million grant and a $2.5 million county bond issue. The $9.3 million solar-electric powered campus on South Highway 61 was occupied in August 1980.

In May, 1980, the college was notified that it had been accredited and had attained membership in the North Central Association of Colleges and Secondary Schools.

In October, 1981, the college began offering courses leading to an Associate degree at the Resident Center at Blytheville Air Force Base. Mississippi County Community College will enroll approximately 1,500 students per semester including students at the Blytheville campus, the Osceola Center, the Blytheville Air Force Base Resident Center, and other locations in Mississippi County.

PHILOSOPHY, PURPOSES AND OBJECTIVES

A. Philosophy

Because Mississippi County Community College is committed to the ideal of the worth and dignity of the individual, its underlying philosophy is to provide opportunities for youth and adults to develop themselves for purposeful, gratifying, and useful lives in a democratic society. The college accepts the national goal of providing at least two years of education beyond the high school level. Paramount in such education are programs of study designed to fit the needs of students of varying educational and vocational goals and those which provide cocurricular activities and community services consistent with the concept of the community college. Operating in the larger context of

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local, state, regional, and national higher educational patterns, the college seeks to respond to the needs of the individual and his level of ability and development.

B. Purposes

Mississippi County Community College is committed to these purposes:

1. To offer programs of study for students who wish to transfer to other institutions to pursue a baccalaureate degree.
2. To offer programs for students who wish to upgrade their skills for employment.
3. To offer programs in general education.
4. To offer non-credit courses which meet community needs.
5. To offer developmental programs to improve basic skills.
6. To offer personalized counseling and support services.
7. To provide a wide range of student activities.
8. To promote the civic and cultural activities of the community.

ACCREDITATION

Mississippi County Community College is accredited by the North Central Association of Colleges and Secondary Schools; is approved by the State Department of Higher Education; the U.S. Department of Education; the State Approving Agency for Veterans; and holds full membership in the American Association of Community and Junior Colleges.

THE ASSOCIATE OF APPLIED SCIENCE DEGREE (AAS)

The Associate of Applied Science Degree is a technical degree designed to prepare the student in some specific occupational area. Persons receiving the AAS normally enter directly into employment in the area of specialization.

The AAS degree requires successful completion of one of the prescribed curriculums that appear on the following pages. This will include the completion of the number of hours specified in that curriculum (minimum 62) with a minimum grade point average of 2.00.

The last fifteen (15) hours of regular course work must be completed at MCCC unless a student has completed 30 or more credit hours at MCCC. In that case, an exception may be granted upon the recommendation of the Academic Standards Committee and the approval of the Dean of Academic Affairs. Regular course work excludes credit-by-examination, sponsored study and C.L.E.P. credit.

Students who plan to complete graduation requirements at the end of any given semester must file an application for graduation with the Registrar's Office no later than the end of the sixth week of that semester.

NOTE: A maximum of seven semester hours of "9" designated courses may be counted toward the sixty-two (62) hour graduation requirements but may not be used to satisfy a specific elective.

A maximum of nine semester hours of cooperative education courses may be counted toward the sixty-two (62) hour graduation requirements but may not be used to satisfy a specific elective.

A minimum of fifteen semester hours of additional course work must be completed for a student to receive a second Associate degree.

The Applied Science Degree in Solar Technology now offered at Mississippi County Community College is a response to the growing public awareness of solar energy as a viable alternative to non-renewable resource technologies.

MCCC recognizes that the need for qualified solar technicians trained in the theories and applications of solar technology will be rapidly expanding with increased research and development commitments by government and private industry. The Solar Technology Program meets the Applied Science objective of preparing students for useful careers in a technical field.

MCCC is in the enviable position of being able to offer qualified students an outstanding learning opportunity both in the classroom and in a lab setting with the world's largest solar photovoltaic campus.

THE SOLAR PROJECT

MCCC is the first civilian institution to receive its energy supply from solar cells. It is the largest photovoltaic project to date and the first comprehensive practical alternative energy package based on solar cells.

The energy portion of the project is a 'large scale experiment' undertaken by the college in cooperation with the U.S. Department of Energy.

MCCC began in 1975 when the college opened its doors for the first time in temporary facilities. As plans for a new campus materialized, the prospects for solar energy funding were explored with the U.S. Energy Research and Development Administration. In 1976 a technical/management proposal was prepared by the college together with its architect/engineer and energy consultants. Final approval for the college to receive a $6.5 million grant was announced on April 29, 1977, with campus completion scheduled for the summer of 1980.

THE PROGRAM

All students who are accepted into the program must first complete the prerequisite courses or their equivalents before entering the Solar Technology sequence. Continuation in the program is contingent upon successful completion of the major related prerequisite and solar technology courses with a minimum grade of 'C' in each course. High school graduates and transfers lacking the prerequisite course work should be prepared to enroll in the prerequisite courses in the fall semester preceding the start of the solar sequence.

This curriculum is a two-year program preparing the student in the theory, instrumentation, monitoring, and maintenance of various heating and cooling solar systems. Although the fundamentals of a flat plate and concentrations technology are dealt with in some detail, the primary emphasis of the solar sequence is on solar cell (photovoltaic) technology and its applications. The student will have the unique opportunity for hands-on experience in this technology with the world's first solar photovoltaic campus.

In addition to going directly into the solar industry upon graduation, some graduates of our program choose to continue their educations in solar or related fields. For exampie, MCCC has an arrangement with the University of Arkansas, Little Rock, which permits our Solar Technology graduates to transfer directly into its Industrial Engineering Program with a Solar Engineering concentration.

ADMISSION TO THE SOLAR PROGRAM

This information is being distributed to persons who have expressed personal interest in the Solar Technology Program or those in a professional role who would like to make others aware of its existence. The two-year curriculum leads to an Associate of Applied Science Degree in Solar Technology.

All students interested in pursuing an AAS in Solar Technology must first meet the basic entrance requirements for admission to MCCC. In addition to application for admission and high school and college transcripts needed by the college, students desiring admission to the Solar Technology Program must submit to the Registrar's Office, ACT or SAT test scores.

Students seeking admission to the Solar Technology Program will be selected by an Admission Committee on the basis of high school and/or college records, ACT or SAT scores,* and date of application.

Graduates of the two-year AAS Degree program may expect to find employment in a variety of solar-related areas —

Solar equipment installation maintenance and repair: Typically, solar technicians in sun-belt cities earn $8.00/hour after one year of experience. Supervisors of solar technicians earn $13,000 per year and up. Our program provides 'hands-on' experience so that the graduate technologist is able to train and supervise solar technicians in their work.

Manufacturing industries which design, test, fabricate and assemble solar systems seek trainees with AAS degrees: Entry-level technologists typically start at $12,000 to 14,000 per year.

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*ACT tests are given at MCCC on a monthly basis. Arrangements for taking the test can be made through the Counselor's Office at MCCC.

ASSOCIATE OF APPLIED SCIENCE DEGREE
IN
SOLAR TECHNOLOGY

This curriculum is a two-year program preparing the student in the theory, instrumentation, monitoring, and maintenance of solar heating and cooling systems. The program is primarily a blend of physical science courses and solar engineering technology. The student will have the unique opportunity to have hands-on experience in this technology in the world's first solar photovoltaic campus. Students will be admitted to the solar technology courses based on successful completion of prerequisite courses.

Freshman

First Semester		Second Semester	
Title	Credit Hrs.	Title	Credit Hrs.
*Plane Trigonometry (482)	3	General Physics II (434)	3
General Physics I (433)	3	General Physics II Lab (434)	1
General Physics I Lab (433)	1	English Composition II (236)	3
English Composition I (235)	3	Basic Electronics (583)	3
Survey of Energy Technology (431)	3	Basic Electronics Lab (583)	1
First Aid (440)	2	Social Science Elective	3
Personal Development (996)	1	Elective	3
	16		17

Sophomore

First Semester		Second Semester	
Title	Credit Hrs.	Title	Credit Hrs.
Solar Technology I (580)	3	Solar Technology II (582)	3
Solar Technology I Lab (580)	1	Solar Technology II Lab (582)	1
Passive Solar Systems (581)	3	**Solar Technology Cooperative Education (890)	3
Introduction to Data Processing (112)	3	Problems in Solar Design (586)	3
Thermal Systems Installation (585)	3	Introduction to Speech Communication (290)	3
Elective	3	Elective	3
	16		16

Recommended Electives:
Calculus, Chemistry, Principles of BASIC Programming, and business courses

*Three and one-half years of senior high school math may be substituted (College Algebra is a prerequisite to Trigonometry). Trigonometry and General Physics I may be taken concurrently as may Basic Electronics and General Physics II. Students with the necessary prerequisites are encouraged to to enter the Calculus sequence.

**The course CE 83911 Career Placement Techniques must be taken as a prerequisite or a corequisite to Cooperative Education and will be included in the total Co-op hours specified.

ST 58003 **Solar Technology I** – This first course in the sequence introduces the student to a variety of topics in the field of solar technology. These include insolation, collectors, power extraction, energy storage and control systems. Prerequisite: Admission to the Solar Technology Program and 43403 General Physics II.

ST 58001 **Solar Technology I Lab** – Concurrent enrollment with 58003 Solar Technology I.

ST 58103 **Passive Solar Systems** – This course introduces the student to a major area of solar radiation utilization that is extremely relevant to today's energy consciousness. This course will focus on how passive solar systems convert the sun's radiation to usable energy through appropriate use of design, building materials, and the local environment. The student will learn about passive systems in the classroom and then be conducted through the local area to look at examples of passive structures that have actually been built. Prerequisite: admission to the solar technology program and 48203 Plane Trigonometry.

ST 58203 **Solar Technology II** – Provides an in-depth study of many of the topics introduced in Solar Technology I. Included are load analysis, thermal power devices, thermal electric generators and electrical power devices. Prerequisite: 58003 Solar Technology I.

ST 58201 **Solar Technology II Lab** – Concurrent enrollment with 58203 Solar Technology II.

ST 58303 **Basic Electronics** – This course will serve to introduce the student to a variety of electronic devices, their basic operation and their characteristics. The student will also be exposed to how electronic devices are used in simple circuits, as well as how these circuits are analyzed and designed. Prerequisite: 43403 General Physics II.

ST 58301 **Basic Electronics Lab** – Concurrent enrollment with 58303 Basic Electronics.

ST 58503 **Thermal Systems Installation** – This course is designed to acquaint the student with the principles and their applications in the area of thermal systems. The actual installation of thermal systems is a major part of the course. Prerequisite: none.

ST 58603 **Problems in Solar Design** – This course will present the student with a practical and current design situation in the field of solar technology. The student will need to call upon previously learned classroom and hands-on skills for successful completion of the course. Prerequisite: 58003 Solar Technology I.

ST 587--- **Topics in Solar Technology** – This series of courses provides the student with technology skills related to the field of solar energy. Variable credit – one to three hours. Prerequisite: 58003 Solar Technology I or consent of instructor.

TEXAS STATE TECHNICAL INSTITUTE

SOLAR ENERGY TECHNOLOGY
CURRICULUM 1983-1984

		PERIOD PER WEEK		
FIRST QUARTER		LEC.	LAB.	CR.
SOL 100	Introduction to Solar Energy Technology	1	0	1
SOL 108	Domestic Hot Water Systems	2	4	3
ACT 113	Basic Refrigeration Skills	2	6	4
ACT 118	Basic Control Principles	3	3	4
DDT 112	Blueprint Reading	1	3	2
MTH 116	Algebra for Industry I	3	2	4
		12	18	18
SECOND QUARTER				
SOL 102	Solar Collectors	2	4	3
SOL 104	Residential Load Calculations	3	3	4
SOL 106	Heat Storage	2	3	3
ACT 122	Heating Equipment	2	3	3
MTH 117	Algebra for Industry II	3	2	4
		12	15	17
THIRD QUARTER				
SOL 208	System Installation	2	6	4
SOL 210	System Configurations	2	2	3
SOL 212	Solar Controls	2	2	3
ACT 212	Cooling Equipment	3	6	5
DDT 116	Basic Drafting	2	3	3
		11	19	18
FOURTH QUARTER				
SOL 204	Solar Air Conditioning	3	3	4
SOL 206	Air Distribution	2	4	3
ACT 222	Troubleshooting	3	6	5
GT 112	Human Relations	2	2	3
MTH 120	Applied Trigonometry	3	2	4
		13	17	19
Exit Point for Solar Equipment Installer				
FIFTH QUARTER				
SOL 316	Commercial Load Calculations	3	3	4
SOL 318	Solar Radiation	3	3	4
ACT 216	Psychrometrics	3	3	4
ACT 224	Piping and Liquid Balancing	2	3	3
BCT 114	Principles of Building Design	2	3	3
		13	15	18
SIXTH QUARTER				
SOL 302	Energy Conservation	3	3	4
SOL 308	System Cost Estimating	3	3	4
SOL 310	Solar Economics	3	3	4
SOL 312	Solar Calculations	3	3	4
TWG 108	Introduction to Technical Communications	2	2	3
		14	14	19

SEVENTH QUARTER

SOL 300	System Design and Control	3	3	4
SOL 314	System Design	3	6	5
GT 213	Job Interview Techniques	2	0	2
GT 310	Elements of Supervision	2	2	3
TWG 202	Technical Report Writing	2	2	3
	Approved Elective			3
				20

SOL 100 Introduction to Solar Energy Technology (1-0-1) This course introduces the student to the field of solar energy and the job entry specifications for the program. Also covered are the organizational structure, policies, and procedures for the TSTI-Waco campus.

SOL 102 Solar Collectors (2-4-3) This is a study of the types of radiation reaching the earth's surface and of the basic types of solar collectors.

SOL 104 Residential Load Calculations (3-3-4) A manufacturer or utility company's short form and ASHRAE'S procedures will be used to calculate residential heating and cooling requirements from data secured from architectural plans and from actual field measurements. Prerequisites: DDT 112 and MTH 116.

SOL 106 Heat Storage (2-3-3) This is a study of the various methods of storing heat. The student will learn the advantages and disadvantages of each and how to size and construct each type for a given load condition. Prerequisite: MTH 116.

SOL 108 Domestic Hot Water Systems (2-4-3) This is a study of domestic hot water and swimming pool heating systems. It includes selecting the most applicable system for the job, sizing components, and estimating system costs.

SOL 204 Solar Air Conditioning (3-3-4) This is a study of the various cooling devices that can be powered by solar energy. It includes the absorption system, ranking cycle vapor compression system, and the triethylene glycol open cycle air conditioning system. Prerequisite: ACT 113.

SOL 206 Air Distribution (2-4-3) This course covers the design of building air distribution systems. Areas of study include ductwork, supply and return devices, insulation, and centrifugal fans. Prerequisite: SOL 104.

SOL 208 System Installation (2-6-4) This course covers the skills required to install, maintain, and troubleshoot solar systems. Areas of study include the installation of all major components and subsystems, and measurement and adjustment of all variables to assure that system is operating at peak design conditions.

SOL 210 System Configurations (2-2-3) This is a study of basic system configurations and their operating modes. Included are air and liquid systems for domestic hot water, space heating, space cooling, and pool heating, as applicable.

SOL 212 Solar Controls (2-2-3) This course deals with the general control strategy for both air and liquid systems. Control systems and hardware for various system configurations are studied.

SOL 300 System Design and Control (3-3-4) A study of design and control of environmental air conditioning systems. The student is encouraged to apply technical knowledge and skills of air conditioning systems to design specifications to arrive at a plant facility that is economically and operationally acceptable.

SOL 302 Energy Conservation (3-3-4) Existing buildings and plans for proposed buildings will be evaluated and recommendations made relative to energy conservation measures and the feasibility of installing a solar system. Areas of study include the building envelope, internal loads, system design considerations, operation of equipment, and space for solar equipment. Prerequisites: SOL 104, SOL 106, SOL 108, SOL 206, and BCT 114.

SOL 308 System Cost Estimating (3-3-4) In this course the student will learn to accurately estimate the total installed cost of a solar system. The forces acting to

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both encourage and discourage the utilization of solar energy are also included in this study. Prerequisite: Completion of first five quarters.

SOL 310 Solar Economics (3-3-4) In this course the student will learn to perform a solar economic analysis. The analysis includes all costs and savings as applicable to residential and income producing properties. Prerequisite: Completion of first five quarters.

SOL 312 Solar Calculations (3-3-4) The fraction of load supplied by solar for any known collector array will be calculated using the F-chart method. Prerequisite: Completion of first five quarters.

SOL 314 System Design (3-6-5) Knowledge gained in previous courses will be used to completely design a liquid or an air type solar heating and domestic hot water system. The finished design will include all calculations, installation drawings, and an economic analysis. Prerequisite: Completion of first six quarters.

SOL 316 Commercial Load Calculations (3-3-4) In this course the student will learn to calculate heating and cooling loads for commercial buildings in accordance with the procedures set forth in the 1977 ASHRAE Handbook of Fundamentals. Prerequisite: SOL 104.

SOL 318 Solar Radiation (3-3-4) Solar radiation available at the tilted surface of the collector and the collector performance will be studied in detail. Prerequisites: SOL 102, MTH 116, MTH 117, and MTH 120.

TEXAS STATE TECHNICAL INSTITUTE
AIR CONDITIONING AND REFRIGERATION TECHNOLOGY
CURRICULUM WITH SOLAR OPTION 1984-85

	PERIOD PER WEEK		
	LEC.	LAB.	CR.
FIRST QUARTER--FALL			
ACT 100 Orientation for Air Conditioning & Refrigeration	1	0	1
ACT 112 Shop Safety & Skills	0	6	2
ACT 114 Principles of Refrigeration 1	3	3	4
ACT 118 Basic Control Principles	3	3	4
MTH 116 Algebra for Industry 1	3	2	4
CHT 102 Applied Chemistry	3	3	4
	13	17	19
SECOND QUARTER--WINTER			
ACT 122 Heating Equipment	2	3	3
ACT 124 Principles of Refrigeration 11	2	3	3
CHT 110 Chemistry for Air Conditioning	3	3	4
DDT 116 Basic Drafting	2	3	3
MTH 117 Algebra for Industry 11	3	2	4
TWG 108 Introduction to Technical Communications	2	2	3
	14	16	20
THIRD QUARTER--SPRING			
ACT 210 Principles of HVAC Design 1	1	3	2
ACT 212 Cooling Equipment	3	6	5
ACT 216 Psychrometrics	3	3	4
MTH 120 Applied Trigonometry	3	2	4
SOL 214 Basic Solar Systems	3	3	4
	13	17	19
FOURTH QUARTER--SUMMER			
SOL 220 Solar Components & Controls	3	3	4
SOL 222 Solar System Installation	3	6	5
SOL 224 Solar System Performance	3	6	5
TWG 202 Technical Report Writing	2	2	3
	11	17	17
FIFTH QUARTER--FALL			
ACT 220 Principles of HVAC Design 11	1	3	2
ACT 222 Troubleshooting	3	6	5
ACT 224 Piping and Liquid Balancing	2	3	3
ACT 226 Commercial A/C Load Calculation	3	3	4
ACT 228 Principles of Automatic Control Systems & Pneumatics	3	3	4
	12	18	18
SIXTH QUARTER--WINTER			
ACT 312 Large Tonnage Cooling & Heating Systems	1	6	3
ACT 316 Air Distribution Design	3	3	4
ACT 318 Principles of Electric-Electronic Controls	3	3	4
GT 112 Human Relations	2	2	3
GT 213 Job Interview Techniques	2	0	2
GT 220 Elements of Law	3	0	3
	14	14	19

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SEVENTH QUARTER--SPRING

ACT 324 Air Balancing & Testing	3	3	4
ACT 326 Advanced System Design	3	6	5
ACT 328 Control System Design	2	6	4
SOL 310 Solar Life Cycle Costing or System Economics	2	3	3
ACT 330 Employment Survey	0	2	1
	10	20	17

EIGHTH QUARTER--SUMMER

SOL 320 Job Cost Estimating	2	3	3
SOL 322 Solar Applications	2	3	3
SOL 324 Energy Conservation & Passive Systems	3	3	4
SOL 326 Photovoltaics	2	3	3
SOL 328 Solar System Design	3	6	5
	12	18	18

CENTRAL TEXAS COLLEGE

Following unparalleled achievement, Central Texas College, a public community college, has evolved from a barren field in Central Texas to a multimillion-dollar educational complex. It all began in 1965, when Central Texans voted to create a college district. From the beginning, the challenge was enormous. The question was clear—whether to develop a traditional community college or dare to create a master plan for the future. Only time would reveal that Central Texas College was destined to become a leader in providing educational services for the Twentieth Century.

The Board of Trustees, together with business and industrial personnel, educators, military leaders, and a dedicated staff under the guidance of Dr. Luis M. Morton, formed the master plan for one of the most successful educational experiences America has ever witnessed. The union of minds developed a totally new educational complex to serve the total career development needs of a local population, as well as the needs of military and civilian personnel throughout the world.

Considering cost effectiveness, efficiency, and immediate application to present needs and future growth, it was clearly recognized that no single educational institution could provide all the programs to meet the career development needs of people in commerce, business and industry, military, government, and the world society. Central Texas College provides a "total career educational program" beginning at the associate degree level of instruction. The organization represents unique educational offerings which contribute to the total effectiveness of services provided through education and training utilizing a myriad of delivery systems.

Worldwide Services:

Having initially supported the United States Army locally with a wide variety of educational programs tailored to meet the specific needs of the military, Central Texas College was chosen to serve our armed forces across the nation and overseas. This commitment to provide expanded educational opportunities carries the same thrust of dedication which is characteristic of Central Texas College.

Central Texas College provides the opportunity for higher education to military personnel serving our country in the United States and in foreign lands. Technical-vocational programs are offered by the College at over 200 locations throughout Europe and the Far East, as well as at military bases in the United States and to the United States Navy, Pacific and Atlantic Fleets. For further information concerning College offerings around the world, the Continental and Overseas Catalogue Supplement should be consulted.

GENERAL INFORMATION

HISTORY

To provide increased opportunities in higher education, the voters of the Killeen and Copperas Cove Independent School Districts and the Nolanville Common School District created the Central Texas Union Junior College District in July, 1965. A $2,000,000 bond issue to construct and equip the campus followed in October, 1965. In January, 1966, the Board of Trustees employed Dr. Luis M. Morton as President of Central Texas College and offices were opened in Killeen that same month. In June of that same year, ground breaking ceremonies were held and the first classes were held in September 1967. Since that time Central Texas College has expanded its physical plant to the present twenty-nine buildings. Current student population at the Killeen Campus is approximately 5,000 per semester.

The 560-acre campus, located on U.S. Highway 190 between Killeen and Copperas Cove, Texas, was dedicated "...to the service of the people..." on December 12, 1967, by the 36th President of the United States, Lyndon Baines Johnson.

EDUCATIONAL PHILOSOPHY

Central Texas College is dedicated to the philosophy that in a democracy, the well-being of the individual, as well as the whole of the society, depends upon the sound moral and educational development of its people. Since education is an individual, evolutionary, and never-ending process, the College curricula are both flexible and extensive.

In order to ensure the fullest service possible to the civilians of the surrounding area, to the personnel of the large military installation adjacent to the Killeen campus and to the personnel of military installations around the world, the educational programs of the College are designed to meet the needs of full-time and part-time students. To accomodate diverse educational needs, Central Texas College provides a variety of educational programs.

The objective of Central Texas College is to become a total learning environment, encompassing traditional and non-traditional forms of education. The guiding principle of the total learning environment is the College's commitment to meet the real educational needs of all the people. The College proposes to make available, in its total environment, the opportunity to achieve success in life, which is the birthright of every American.

EDUCATIONAL OBJECTIVES

1. UNIVERSITY PARALLEL EDUCATION - The College provides the first two years of study for those students who expect to transfer to a senior college or university to complete a baccalaureate or professional degree.

2. GENERAL EDUCATION - The College provides general education courses which develop competence, skills, and attitudes essential to effective performance as an individual, as a citizen, and as a productive member of society. Within this academic framework are studies in communication and languages, social sciences and humanities, mathematics, physical and social development, as well as a program of co-curricular activities.

3. OCCUPATIONAL EDUCATION - The College offers comprehensive curricula and individual courses in day, evening and weekend classes to students who are interested in preparing for careers in a variety of business, health, industrial, and technical occupations. Transfer of these credits to senior colleges and universities offering baccalaureate degrees in technology or applied science is possible for those students seeking advanced study.

4. CONTINUING EDUCATION SERVICES - The College provides continuing education for adults, including opportunities for cultural enrichment, special interest courses, lectures and meetings. Continuing education services are provided to individual adults, business, industrial, and military organizations.

5. COUNSELING AND PERSONAL GUIDANCE - The College provides counseling and guidance services which enable the student to select, with proper perspective, the educational program that is compatible with individual abilities, aptitudes and ambitions.

6. PLACEMENT - The College provides an employment/placement service to assist graduating students and alumni in bringing their qualifications to the attention of possible employers.

7. RESEARCH - Through a sponsored activity, the Research Institute for Advanced Technology, the College provides computer and telecommunications services and conducts energy and educational research.

8. SKILLS TRAINING - Through a support activity, the Vocational Skills Center, the College provides individualized vocational skills training programs.

CERTIFICATE & DEGREE REQUIREMENTS

WHAT DEGREES ARE OFFERED

Central Texas College confers the Associate in Arts, the Associate in Science, the Associate in Applied Science, or the Associate in General Studies degree upon students who have completed all the general and specific requirements for graduation. Degrees are conferred three times each year, in December, May and August. It is the student's responsibility to make application for the degree. Each degree candidate must earn a minimum of 12 semester hours in traditional study at Central Texas College.

A person may normally be awarded one degree from Central Texas College. Students wishing to be awarded a second degree must satisfy all requirements for the second degree, including at least 12 additional semester hours of traditional courses in residence at Central Texas College. The additional 12 semester hours must be completed after the award date of the first degree. This requirement is in addition to those requirements already completed for the award of the first degree. The Associate in General Studies Degree may not be awarded more than once to any student.

AIR CONDITIONING & REFRIGERATION
SOLAR ENERGY OPTION

A Two-Year Associate in Applied Science Degree

FIRST YEAR

First Semester			Credit	Second Semester			Credit
AIRC	1400	Air Conditioning & Refrigeration, Theory & Application	4	AIRC	1403	Heating Systems	4
AIRC	1401	Basic Electrical Circuits	4	AIRC	1405	Test Instruments	4
ENGL	1309	Communications Skills	3	SESY	1401	Solar Heating and Cooling Systems	4
WELD	1401	Beginning Gas Welding	4	TMTH	1300	Technical Mathematics I	3
PSYC	1101	College Orientation	1	PYED		Physical Education	1
PYED		Physical Education	1				16
			17				

SECOND YEAR

First Semester			Credit	Second Semester			Credit
AIRC	1404	Residential Air Conditioning	4	SESY	2402	Solar Energy Special Projects	4
AIRC	2401	Control Theory and Application	4	MTNT	1401	Carpentry I	4
SESY	2401	Solar Systems Design	4	BUSS	1301	Introduction to Business	3
DRDS	1400	Fundamentals of Drafting	4	ELCT*		Approved Elective	4
			16	ELCT		Elective	3
							18
						TOTAL HOURS	67

*Approved Electives: AIRC 2402, AIRC 2403, DRDS 1303, MTNT 2403, WELD 1402.

AIR CONDITIONING & REFRIGERATION

A Two-Year Associate in Applied Science Degree

FIRST YEAR

First Semester			Credit	Second Semester			Credit
AIRC	1400	Air Conditioning & Refrigeration, Theory & Application	4	AIRC	1402	Household Refrigeration	4
AIRC	1401	Basic Electrical Circuits	4	AIRC	1403	Heating Systems	4
WELD	1401	Beginning Gas Welding	4	AIRC	1405	Test Instruments	4
ENGL	1309	Communications Skills	3	TMTH	1300	Technical Mathematics I	3
PSYC	1101	College Orientation	1	PYED		Physical Education	1
PYED		Physical Education	1				16
			17				

SECOND YEAR

First Semester			Credit	Second Semester			Credit
AIRC	1404	Residential Air Conditioning	4	AIRC	2403	Commercial Air Conditioning Systems	4
AIRC	2401	Control Theory and Application	4	AUTO	1405	Automotive Air Conditioning	4
AIRC	2402	Commercial Refrigeration Systems	4	BUSS	1301	Introduction to Business	3
DRDS	1400	Fundamentals of Drafting	4	ELCT*		Approved Elective	4
			16	ELCT		Elective	3
							18
						TOTAL HOURS	67

*WELD 1402, MGMT 1306, MTNT 1401, MTNT 2403, DRDS 1303 or other elective approved by the Department Manager.

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Air Conditioning and Refrigeration (AIRC)

AIRC 1400 Air Conditioning & Refrigeration Theory & Application (2-4) Credit: 4

This course deals with the basic physical principles of an air conditioning system. Introduction to heat, heat movement, temperature, pressure, refrigerants, temperature pressure relationship to refrigerants, the refrigeration cycle, the major components of refrigeration system and their relationship to each other. Introduction to the basic electrical devices found in air conditioning systems, i.e., motors, controls, etc. Use of special air conditioning tools and equipment, soldering and welding equipment. The use and care of specialized electrical testing and recording instruments is stressed.

AIRC 1401 Basic Electrical Circuits (2-4) Credit: 4

Instruction in basic electricity and its application. Introduces the student to the various electrical devices, their importance in electrical circuits, including those used in residential wiring. Methods of wire connections for new and repair service, making and testing electrical circuits, and the use of electrical measuring and testing equipment.

AIRC 1402 Household Refrigeration Systems (2-4) Credit: 4

Application of the refrigeration cycle to household refrigeration, including refrigerators, home freezers, and window air conditioning units. Instruction in service procedures for locating and correcting problems in the mechanical and electrical systems of units; trouble shooting, repairing and charging refrigeration equipment. Development of shop skills in the use of special refrigeration tools and equipment. Prerequisites: AIRC 1400 and AIRC 1401 or MTNT 1402.

AIRC 1403 Heating Systems (2-4) Credit: 4

The study of types of heating equipment and their application. Service procedures for locating and correcting problems in heating systems. Study of manufacturers information on various heating units and equipment, to enable the student to determine proper installation. Prerequisites: AIRC 1400 and AIRC 1401 or MTNT 1402.

AIRC 1404 Residential Air Conditioning (2-4) Credit: 4

Instruction in heat transfer through material, heat loss and heat gain calculations for residential heating and air conditioning systems, equipment selection and location, duct sizing and layout, controls and control circuits installation and service procedures. Prerequisites: AIRC 1400 and AIRC 1401 or MTNT 1402.

AIRC 1405 Test Instruments (3-3) Credit: 4

This course will provide the student with an understanding of the special instruments used in the diagnosis of problems in heating, air conditioning and solar energy equipment. Both the care and use of the instruments will be covered.

AIRC 2401 Control Theory and Application (2-4) Credit: 4

Instruction in the operation of control devices, how they can be applied and varied to achieve the designed conditions. Includes interpretation and drawings of schematic and pictorial control circuit diagrams. Prerequisites: AIRC 1400 and AIRC 1401 or MTNT 1402.

AIRC 2402 Commercial Refrigeration Systems (2-4) Credit: 4

Types of commercial refrigeration units and systems. Instruction in controls and control circuits in commercial refrigeration. Heat loss and heat gain calculations for commercial applications, equipment selections, locating and piping procedures. Instruction in installation and service procedures for different systems. Prerequisites: AIRC 1400 and AIRC 1401 or MTNT 1402.

AIRC 2403 Commercial Air Conditioning Systems (2-4) Credit: 4

A course designed to cover heat transfer, heat loss and heat gain calculations as applied to commercial heating and air conditioning. Psychometrics of conditioned air, duct design and layout, equipment selection and location, shop drawings, controls and control circuits for automatic conditioning of air. Prerequisites: AIRC 1400 and AIRC 1401 or MTNT 1402, AIRC 1404.

Solar Energy (SESY)

SESY 1401 Solar Heating and Cooling Systems (3-3) Credit: 4

This course is an introduction to solar heating and cooling systems. Topics of instruction will include an overview of this basic system components of both solar heating and solar cooling systems, and the operation, installation, maintenance, trouble-shooting, and service procedures of solar heating and solar cooling systems. Prerequisites: AIRC 1403 and AIRC 1404.

SESY 2401 Solar Systems Design (3-3) Credit :4

This course is an introduction to solar systems design. Topics of instruction will include an overview of the basic architectural design of the structures to collect, store and distribute the heat to various parts of the structure by natural means. Prerequisite: SESY 1401.

SESY 2402 Solar Energy Special Projects (1-5) Credit: 4

This course covers practical experience on a special project(s) involving an application of solar energy heating and/or cooling systems. Under the supervision of the instructor, the student selects a project that includes the design, fabrication, installation, calibration, operation and maintenance of a solar system. Solar energy systems standards, local building code requirements and cost analysis are also included. Prerequisites: SESY 1401, SESY 2401.

PURPOSES

Navarro College presents curricula to serve the educational and cultural needs of the region in which the college is located. Navarro recognizes the importance of the individual student and strives for excellence in meeting the seven purposes as stated in the Texas Education Code, Section 130.003.

The purpose of each public community college shall be to provide:

(1) technical programs up to two years in length leading to associate degrees or certificates;

(2) vocational programs leading directly to employment in semi-skilled and skilled occupations;

(3) freshman and sophomore courses in arts and sciences;

(4) continuing adult education programs for occupational or cultural upgrading;

(5) compensatory education programs designed to fulfill the commitment of an admissions policy allowing the enrollment of disadvantaged students;

(6) a continuing program of counseling and guidance designed to assist students in achieving their individual educational goals; and

(7) such other purposes as may be prescribed by the Coordinating Board, Texas College and University System, or local governing boards, in the best interest of post-secondary education

Under the authorization and encouragement of its local Board of Trustees, Navarro College conducts numerous research and development projects to improve its service to its region.

PHILOSOPHY

Navarro College shares with its counterparts throughout America a potentially affecting influence in higher education today; community colleges are the most flexible segment of education in this country. They observe and listen to their constituency, and they adapt accordingly, wanting always to be of better, more valuable service to their students. Navarro College has deep respect for the past and its richness; it also looks to the future, aware that mankind's best hope for survival lies in one of the chief tenets of education: an informed, intellectually liberated populace which enjoys the freedom to think independently of tradition, to be aware of the concepts currently shaping the modern world, and to prepare for the careers of its choice.

The Board of Trustees, administration, faculty, and staff of the College have chosen to dedicate themselves to helping students, whatever their intellectual or vocational aspirations, toward their enlarged worlds and more abundant existences. The College cares genuinely about its students and is aware of them as individual learners who have particular needs. Its students and their welfare are the College's constant concern, and the strengths of the institution are best measured in the successes of its students. One educator has said that "the most difficult and complex, the most challenging, and the most rewarding sort of teaching is that in which the student is a beginner." It may well be true; it could explain the stimulation found in community college education today: that interaction between a vital, flexible institution and its awakening, curious body of students.

Dean Linton of George Washington University has remarked that "if a student while in college can learn to write with some clarity and facility; to think with reasonable vigor and orderliness; to become acquainted with the past; to begin to explore the vast realm of

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literature and art and music; to take a few paces into the marvels of science and number; to sense in some measure the power and beauty of virtue; to practice at least a little civility and compassion toward others; to inaugurate (in short) an acquaintanceship with and a desire to emulate the best that has been thought and said in the history of the world . . . it will be an investment that will pay dividends both to him and society."

HISTORY

In 1946 a group of Navarro County citizens met to form a steering committee for the purpose of establishing a junior college. A public election was held on July 16, 1946, to elect the first Board of Trustees and authorize a local tax to support the newly formed junior college.

The first class of students entered in September 1946. The initial college enrollment was 238 students. The first campus of Navarro Junior College was located on the property of the Air Activities of Texas, a World War II primary flying school facility, six miles south of Corsicana.

In 1951 the campus was moved to its present location in the city limits of Corsicana on State Highway 31 West. In 1954 the college received accreditation from the Southern Association of Colleges and Schools. This accreditation was reaffirmed in December 1974.

During 1974 the college broadened its philosophy and purposes to encompass the comprehensive community based educational concept, adding new occupational education programs and implementing new educational concepts including individualized and self-paced instruction and the use of audio-tutorial instructional media. In keeping with this new educational role, the word "Junior" was dropped from the name, and the official name of Navarro College was adopted by the Board of Trustees.

SOLAR ENERGY

PROGRAM INFORMATION: The two-year technician program shown below prepares a person to (1) apply knowledge to science and mathematics extensively and render direct technical assistance to scientists and engineers engaged in solar energy research and experimentation, (2) design, plan, supervise, and assist in installation of both simple and complex solar systems and solar control systems, (3) supervise, or carry out, the operation, maintenance, and repair of simple and complex solar systems and solar control systems, (4) design, plan, and estimate costs as a field representative or salesperson for a manufacturer or distributor of solar equipment, (5) prepare or interpret drawings and sketches and write specifications or procedures for work related to solar systems, and (6) work with and communicate with both the public and other employees regarding the entire field of solar energy. The one-year program prepares students to install and maintain solar equipment.

SOLAR ENERGY TECHNICIAN
FRESHMAN YEAR

FALL

Subjects	Sem. Hrs.
Math. 1313 Tech. Math I	3
I.E. 1013 Eng. Drawing I	3
S.E. 1112 Intro. to Solar Energy	2
S.E. 1123 Mat. & Mat. Handling	3
S.E. 1134 Energy Science I	4
Psy. 1011 Ed. & Career Planning	1
	16

SPRING

Subjects	Sem. Hrs.
Math. 1323 Tech. Math II	3
Engl. 1013 Comp. & Rhetoric	3
A.C. 1014 Air Cond. Principles	4
S.E. 1144 Energy Science II	4
S.E. 1154 Col. & Energy Stor.	4
	18

SOPHOMORE YEAR

FALL

Subjects	Sem. Hrs.
CS 1014 Data Entry	4
Elec. 1023 Basic Elect. Lab.	3
Bus. 1413 Intro. to Bus.	3
S.E. 2114 Sizing, Design & Retrofit	4
S.E. 2123 Tech. Survey of Energy Sources	3
	17

SPRING

Subjects	Sem. Hrs.
Engl. 1033 Tech. Report Writ.	3
Psy. 1213 Gen. Psychology	3
S.E. 2133 Operational Diagnosis	3
S.E. 2142 Eco., Codes & Legal, Consumerism	2
S.E. 2153 Non-Resident App. & Future Tech.	3
S.E. 2163, 2164, 2165 Solar Practicum	3-5
	17-19

SOLAR INSTALLER/MECHANIC
One-Year Certificate Program

FALL

Subjects	Sem. Hrs.
A.C. 1014 Air Cond. Prin.	4
A.C. 1024 Basic Elec. Cir.	4
A.C. 1054 Resid. Air Cond.	4
Math. 1313 Tech. Math.	3
S.E. 1013 Intro. to Solar Heating & Cooling	3
	18

SPRING

Subjects	Sem. Hrs.
A.C. 2014 Control Theory & Apl.	4
Psy. 1223 Personality & Adj.	3
S.E. 1034 Mat. & Fabrication	4
S.E. 1044 Col. & Ener. Storage, Installation & Servicing	4
S.E. 1064 Solar Heating & Cooling Systems I	4
	19

SUMMER SESSION

Subjects	Sem. Hrs.
S.E. 1074 Mat. & Fabrication II	4
S.E. 1084 Solar Heating & Cooling Systems II	4
	8

SOLAR ENERGY

SE 1013 INTRODUCTION TO SOLAR HEATING AND COOLING 2 lec/1 lab (3 Cr.)
General introduction to fundamental concepts of solar space heating and cooling, domestic water heating, and solar generated electricity. Centralized and decentralized solar utilization are discussed. Solar thermal aspects (high temperature, medium temperature and low temperature collector) of space conditioning will be reviewed. Solar equipment manufacturers and products are identified. Hands-on laboratory activities with simulated solar components and systems will be conducted by students to provide quantitative background.

SE 1034 MATERIALS AND FABRICATION I 2 lec/4 lab (4 Cr.)
Emphasis on use of simple mechanical and electrical hand tools. Welding, soldering, brazing, glazing, sheet metal work, tubing and piping fabrication (both metal and plastic) and gaskets and seals will be included. Taught with solar applications in mind to give the student experience and confidence in such operations.

SE 1044 COLLECTORS AND ENERGY STORAGE, INSTALLATION AND SERVICING 2 lec/4 lab (4 Cr.)
Fundamentals of flat plate and focusing collectors. Methods of collector installation are studied and applied. Advantages and disadvantages are compared as to various types of installations. Students will trouble shoot collectors and energy storage systems will be studied. Also, basics of work on, assemble and set up a storage unit with proper insulation and flow pattern.

SE 1064 SOLAR HEATING AND COOLING SYSTEM I 2 lec/4 lab (4 Cr.)
This course will teach the student how the collector and storage systems are integrated with conventional space conditioning and industrial process systems. Students will learn control system logic and will apply this knowledge to functional solar systems.

SE 1074 MATERIALS & FABRICATION II 2 lec/4 lab (4 Cr.)
A continuation and more in-depth treatment of Materials & Fabrication I to include duct work, flashing, concrete, painting and carpentry.

SE 1084 SOLAR HEATING & COOLING SYSTEMS II 2 lec/4 lab (4 Cr.)
A continuation and more in-depth treatment of Solar Heating and Cooling Systems I.

SE 1112 INTRODUCTION TO SOLAR ENERGY 2 lec (2 Cr.)
Overall view of total range of topics to be covered in the two-year curriculum. Covers relationships between conservation measures, passive solar design and reduced size of active solar systems needed as a result of conservation measures.

SE 1123 MATERIALS AND MATERIAL HANDLING 1 lec/4 lab (3 Cr.)
Lecture and laboratory portions train student to handle and work with materials utilized in Solar installation. Included are basics of plumbing, sheet metal workings, carpentry, roofing, soldering, welding, and other related techniques in a solar installation.

SE 1134 ENERGY SCIENCE I 3 lec/3 lab (4 Cr.)
Basic physical principles governing reception, transfer, storage and use of solar energy. Topics include general energy definitions, detailed discussion of principles of temperature, heat transfer and thermodynamics, lights and optics and characteristics in measurement of solar energy.

SE 1144 ENERGY SCIENCE II **3 lec/3 lab (4 Cr.)**

Continuation of Energy Science I. Topics covered include hydrostatics, hydrodynamics, basic electrical considerations, electromagnetic interactions, electromagnetic waves.

SE 1154 COLLECTORS AND ENERGY STORAGE **2 lec/4 lab (4 Cr.)**

Solar Collector types (flat-plate, focusing, evacuated tube, etc.) as examined in detail and relative advantages and disadvantages of each type are discussed. Methods of storing solar energy, including latent and sensible heat storage examined. Relative merits of different sensible heat storage media measured and compared.

SE 2114 SIZING AND DESIGN AND RETROFIT **3 lec/3 lab (4 Cr.)**

Interrelation of parts of a complete solar system (collectors, pumps, heat exchangers, storage pipes, ducts, controls, etc.) are studied and explained. Integration of solar apparatus with conventional auxiliary systems (furnace, heat pumps, etc.) are explored.

SE 2123 TECHNICAL SURVEY OF ENERGY SOURCES **3 lec (3 Cr.)**

Covers relationships between energy supply and demand and relative role solar energy can play in the future.

SE 2133 OPERATIONAL DIAGNOSIS **2 lec/3 lab (3 Cr.)**

Use of instrumentations and measurements to correctly set up and troubleshoot a solar system. Common problems likely to be encountered in a malfunctioning solar system are discussed with symptoms and solutions of these problems explained.

SE 2142 ECONOMICS, CODES, LEGAL, CONSUMERISM **2 lec (2 Cr.)**

Makes student aware of types of governmental documents and action that affect the solar industry and of importance that consumer relations will play.

SE 2153 NON-RESIDENTIAL APPLICATIONS AND FUTURE TECHNOLOGY
2 lec/3 lab (3 Cr.)

Application of solar technology for uses other than home heating and cooling. Included are commercial, industrial, and agricultural applications and conversion of solar energy into electricity, both by central power concept and by photovoltaic cells.

SE 2613, 2164, 2165 SOLAR PRACTICUM **1 lec/9-15 lab (3-5 Cr.)**

A culmination of student's work. Involves on-the-job field testing of student's capabilities, carried out in cooperation with solar industry.

HEATING & COOLING

PROGRAM INFORMATION: The program below is designed to prepare students for employment after two years of college. The Associate in Applied Science degree is awarded upon successful completion of the program.

FRESHMAN YEAR

FALL

Subjects	Sem. Hrs.
A.C. 1014 Air Conditioning Prin.	4
A.C. 1024 Basic Electrical Circ.	4
S.E. 1013 Intro. Solar Heat & Cool.	3
Engl. 1013 Comp. & Rhetoric	3
Math. 1113 Inter. Coll. Algebra	3
Psy. 1011 Ed. & Career Planning	1
	18

SPRING

Subjects	Sem. Hrs.
A.C. 1064 Res. Heat & Cool	4
A.C. 1074 Materials & Fab.	4
S.E. 1064 Solar Heat & Cool Sys. I	4
Elec. 1035 Alt. Current Analy.	5
	17

SOPHOMORE YEAR

FALL

Subjects	Sem. Hrs.
A.C. 2014 Control Theory & Appl.	4
A.C. 2044 Comm. A.C. & Ref.	4
Bus. 1413 Intro. to Business	3
I.E. 1013 Eng. Drawing I	3
S.E. 1084 Solar Heat & Cool Sys. II	4
	18

SPRING

Subjects	Sem. Hrs.
A.C. 2053 Energy Mgt. & Conser. Tech.	3
A.C. 2064 HVAC Piping & Duct Design	4
Engl. 1033 Tech. Report Writing	3
Mgt. 1083 Small Bus. Mgt.	3
Psy. 1223 Personality & Adjust.	3
or	
A.C. 2114 Cooperative Education I	(4)
	16 (17)

A.C. and S.E. courses are listed under the heading "Heating and Cooling" in the Course Descriptions — See page 131.

HEATING AND COOLING

AC 1014 AIR CONDITIONING PRINCIPLES **3 lec/3 lab (4 Cr.)**

Course deals with basic principles of air conditioning systems. Heat, heat movement, temperature, pressure, refrigerants, temperature pressure relationship to refrigerants, the refrigeration cycle, the major components or refrigeration systems and their relationship to each other are introduced. Basic electrical devices found in air conditioning systems such as motors, controls, etc. are also introduced. Use of special air conditioning tools and equipment, soldering and welding equipment and specialized electrical testing and recording instruments is stressed.

AC 1024 BASIC ELECTRICAL CIRCUITS **3 lec/3 lab (4 Cr.)**

Course deals with basic electricity and its application. Various electrical devices, their importance in electrical circuits, including those used in residential wiring are introduced. Methods of wire connections for new and repair service, making and testing electrical circuits and the use of electrical measuring and testing equipment are studied.

AC 1064 RESIDENTIAL HEATING AND COOLING **2 lec/3 lab (4 Cr.)**

Course covers temperature transfer in residential building materials, heat loss and heat gain calculations, heating and cooling systems, equipment selection, installation, service, and maintenance procedures.

AC 1074 MATERIALS AND FABRICATION **2 lec/3 lab (4 Cr.)**

Students will develop skills in welding, soldering, sheet metal work, wiring and piping. Shop fabrication and field installation skills are also studied.

AC 2014 CONTROL THEORY AND APPLICATION 2 lec/3 lab (4 Cr.)
Designed to give an understanding of the operation of various types of control devices, how they can be applied and varied to achieve the designed conditions in various applications. Includes interpretations and drawings of schematic and pictorial control circuit diagrams. Prerequisite: AC 1014 and AC 1024.

AC 2044 COMMERCIAL AIR CONDITIONING AND REFRIGERATION
3 lec/3 lab (4 Cr.)
Course develops fundamentals of commercial space conditioning and refrigeration, heat loss and heat gain calculations, air conditioning and refrigeration equipment, controls, and operation. Installation, service, and maintenance procedures are also discussed.

AC 2053 ENERGY MANAGEMENT AND CONSERVATION TECHNOLOGY
3 lec (3 Cr.)
Course emphasis placed on controlled use and conservation of energy. Students will acquire knowledge and skill necessary to implement energy management and conservation systems. Concepts, system design, equipment selection and installation are studied. Included are energy auditing, cost-effectiveness and energy savings studies.

AC 2064 HVAC PIPING AND DUCT DESIGN 2 lec/3 lab (4 Cr.)
Students will study fundamentals of good piping and duct design, layout, and installation for residential and commercial operations. Students will produce full drawings and specifications for various systems.

AC 2114 COOPERATIVE EDUCATION I 1 lec/20 lab (4 Cr.)
Work experience is open to students in their major career field in occupational education. Under the supervision of the instructor and the employer, the student is provided the opportunity to work for wages and is evaluated by both the instructor and the employer.

SE 1013 INTRODUCTION TO SOLAR HEATING AND COOLING 2 lec/1 lab (3 Cr.)
General introduction to fundamental concepts of solar space heating and cooling, domestic water heating, and solar generated electricity. Centralized and decentralized solar utilization are discussed. Solar thermal aspects (high temperature, medium temperature and low temperature collector) of space conditioning will be reviewed. Solar equipment manufacturers and products are identified. Hands-on laboratory activities with simulated solar components and systems will be conducted by students to provide quantitative background.

SE 1064 SOLAR HEATING AND COOLING SYSTEMS I 2 lec/4 lab (4 Cr.)
This course will teach the student how the collector and storage systems are integrated with conventional space conditioning and industrial process systems. Students will learn control system logic and will apply this knowledge to functional solar systems.

SE 1084 SOLAR HEATING AND COOLING SYSTEMS II 2 lec/2 lab (4 Cr.)
A continuation and more in-depth treatment of Solar Heating and Cooling Systems I.

FINDINGS

This section shall summarize the findings of the on-site visits and telephone surveys of alternative energy programs. The purpose of the on-site visits and telephone surveys was to take advantage of the experiences of those individuals and institutions that have developed and operated alternative energy education programs. The individuals contacted were very generous in sharing their time and experiences. The types of programs surveyed were quite diverse ranging from non-credit vocational training programs to four-year engineering programs. The emphasis was placed on contacting one and two-year vocational, certificate, and degree granting institutions which would have programs that would be applicable to community colleges. A comprehensive analysis of all existing programs was not attempted. This was because of the unavailability of a current and up-to-date listing of programs, the large number of programs that were listed but not in operation, and the number of programs that could be contacted within the available budget. However, enough different programs were contacted and visited to give a reasonably accurate analysis. This section will not present a detailed analysis of each program but will present a summary of important observations with specific references to different institutions.

The history of the solar and alternative energy industry has been changeable and difficult to predict. Solar and alternative energy education programs have had a difficult time keeping up with the industry and equipping their students with marketable job skills. In some cases those educational institutions which have

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selected incorrect educational objectives or have retained outdated objectives have failed, just as businesses that make poor marketing decisions can go out of business. The energy marketplace is affected by many different and dynamic factors as described in the labor marketplace analysis section of this study. This fact makes long-range predictions difficult. For example, when solar energy was emerging in the market most observers saw the future of solar energy development in terms of complex active solar collector systems. Most solar training programs focused on either preparing highly trained solar engineers or equipping technical solar installers with very specific vocational skills. The students in two-year solar programs with a strong emphasis on engineering tended to go on to get traditional engineering degrees. Many of the students in the solar programs were not the types of students who would normally be in engineering programs. Some of them dropped out when they could not handle the math and science requirements of these programs. Others, when they found that they could handle the requirements, dropped out of the programs to get into mechanical engineering or other engineering degree programs. The job market demand for students with two-year solar degrees with an engineering emphasis was not strong. The starting salaries, job security, and job openings looked so much better for students with four-year traditional engineering degrees than two-year solar degrees that many students changed career goals.

The market for individuals specifically and narrowly trained as solar installation technicians has turned out to be much smaller than expected in most regions. According to a Navarro College study, "An Assessment of Need for Developing and Implementing

Technical and Skilled Worker Training for the Solar Energy Industry," 80% of the skills required in solar installations are traditional trades skills, and only 20% are solar specific skills.[1] Dr. David LaHart of the Florida Solar Energy Center at Cape Canaveral, Florida observed that in Florida "educational programs quickly filled the need for installers. Many companies subcontracted the installations with local general contractors and plumbers." He also observed that in Florida, "the big dealers provide their own training programs." It appears that in many regions, existing local contracting or energy service businesses take on solar as a side line and use existing employees to do the installations. This makes it difficult for the solar-trained specialist to enter these jobs. In discussing the Texas area, Carl Kuhnle of the Texas State Technical Institute observed that in his area solar will go with the air conditioning companies. Johnny Weiss, of Colorado Mountain College, of Glenwood Springs, Colorado, said that primarily our people get jobs installing systems, especially active systems, and some of our students get jobs building houses. The patterns vary somewhat in different regions, but the trend seems to be that active solar installations can often be handled by factory-trained installers or by the traditional trades person with some solar training or by on-the-job training. This limits the job opportunities for the narrowly trained solar energy active collector installation specialist. These skills are, however, an employment asset if combined with other marketable skills.

Most instructors surveyed who were working in successful alternative energy programs indicated that students with a broad base of energy skills would be best equipped for finding jobs in

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the energy field. At the Florida Solar Energy Center, a survey and task analysis were done, and according to Dr. David LaHart, their investigations indicated this: "create a generalist and he or she will be able to specialize later." According to Johnny Weiss of Colorado Mountain College, "our people get the overview; they have depth. They are not married to one kind of system. The focus of our program is retrofit, and the jobs today are in retrofit." According to Mr. Schubert of Western Michigan University at Kalamazoo, Michigan, in talking about his region, "jobs are hard to come by in solar; basically we are talking about backyard operations, shoestringers. As far as jobs are concerned, you are going to have to wear more than one hat. Jobs are more in sales than in engineering." Pat Enz of Red Wing Area Vocational Technical Institute in Red Wing Minnesota explained that she had struggled to diversify their program. She explained that the available jobs are diverse and that they were trying to train people in electronic controls, computers, energy management, energy auditing, and traditional energy areas in addition to alternative energy. There is a clear trend that most of the successful alternative energy programs are attempting to provide a diverse education to their students.

Another characteristic that seemed to be common to successful alternative energy education programs was a curriculum that was very frequently being revised and updated. This is due to the rapid development of new technologies, improvements to existing product lines, and the constant changes in the marketplace. According to Johnny Weiss of Colorado Mountain College, "it is a

full-time job to keep up with the products and design." The content of the education that is being provided needs to be frequently updated so that the students can be competitive in the job market. This can be a problem because most educational institutions are not accustomed to this kind of rapid curriculum change. Conrad Heins of Jordan College Energy Institute in Comstock Park, Michigan handed us a draft of a newly revised curriculum and indicated that it was difficult to explain to college administrators the need for such frequent changes. Jordan College Energy Institute was in the process of adding an energy management certificate program and making important changes in their curriculum to reflect changes in the market and the industry.

An important tool for keeping an energy curriculum current is an industry council. Many of the programs surveyed had active industry councils and emphasized the important role that these councils played in keeping educators current on the needs of employers. Industry councils also keep educators attuned to developments in regional market trends. This is important because substantial differences in the nature and focus of the energy industry were noted in different regions. In many cases these differences might be attributed to differing climates, tax credits, utility costs, or local economies. But in some cases the causes of the differences would be very difficult to determine or predict without direct market experience. The input of a regional industry council is an invaluable part of educational planning and curriculum revision. It may be advisable to include other energy professionals along with industry representatives on a council.

Another trend that seems to be common to all of the programs

surveyed is the fact that the students in these programs came from diverse geographic locations. None of the institutions surveyed depended solely on local students; all had a mix of in-district, out-of-district, and out-of-state students. The students also seemed to be different than the average student. According to Leary O'Gorman at Colorado Technical College at Colorado Springs, they are "serious students. They will move families and get part-time jobs to get their degrees." He called the solar students the "conscience of the college."

Many of the campuses visited had received substantial grants, including U.S. D.O.E. (Department of Energy) grants, to assist in the starting of their programs. These grants were used primarily for equipment purchases, for labor market analysis, and for curriculum development. However, the receipt of substantial grant dollars seemed to be no guarantee that a program would survive. Many of the programs that had received grants were no longer in existence or were considering merging solar programs with other healthier programs. It was not possible within the scope of this study to analyze this phenomenon in depth. It does seem clear that those institutions that have administrations with strong commitments to alternative energy education programs have good records in sustaining effective programs. We are in an era when many educational institutions are experiencing declining enrollments. Alternative energy programs are, in most institutions, experiencing declining enrollments. It is difficult for the designers of alternative energy education programs to keep these programs current with the job market. It is also difficult for students to see what the job futures are in the energy fields

and select the appropriate educational programs. This means that alternative energy programs can expect to experience some changes and difficulties as they develop. They cannot expect to "turn a profit" every year of their operation. This type of environment calls for educational leadership. Some institutions, such as Jordon College in Michigan and Ball State in Muncie, Indiana, have demonstrated the important role of administrative leadership. Bob Koester, the head of the program at Ball State, explained that the role of administrative leadership has been very important in their programs. Their program is not currently funded by substantial outside grants; it is funded by re-appropriated funds in-house. The administration has made hiring faculty for their energy programs a priority. The administration also has instituted a system of internally funded research grants for the faculty. Last summer eleven faculty members received support to do research in the energy areas. The enrollment in Ball State's energy programs has increased this year. Those energy education programs that benefit from strong, clear-headed educational leadership will be the programs that will experience growth, will set the patterns for others to follow, and will educate those who will begin to solve the energy problems of today and tomorrow.

Attracting students is a crucial component in maintaining an active energy educational program. Most of the programs contacted had been experiencing difficulty in attracting students. Some programs had folded due to insufficient enrollment or had merged or were considering merging with existing programs. Determining the best ways to attract students is very important.

Different institutions had different experiences as to what were the most effective method(s) for them. The types of methods that were successful can be summarized as follows: developing aggressive promotion programs, developing a high quality education that attracts students by word-of-mouth from successful graduates, constructing visible demonstrations of alternative technologies which seem to draw students by demonstrating an institution's commitment to alternative technologies, and establishing strong administrative support coupled with an enthusiastic faculty. The different institutions surveyed that were successful in attracting students used one or more of these methods. Aggressive promotion seems to be one of the more important elements, but some institutions had good enrollment without strong promotion. These programs were promoted using a number of different methods, such as advertising in journals such as Solar Age and recruiting directly at conferences and on high school campuses. Some administrators and instructors had extensive speaking schedules. Degree granting programs were also promoted by drawing students who had attended workshops and other training programs. A number of the individuals interviewed indicated that it was important to maintain a steady push of promotion and that some of their difficulties with enrollment may have been due, in part, to relaxing promotional activities. It may well be that the promotional requirements of these types of alternative energy education programs will require a more structured type of promotional program than is usually seen in community colleges.

FINDINGS: ELECTRONICS PROGRAMS AND SOLAR ENERGY TECHNOLOGY

Mississippi County Community College - Blytheville, Arkansas

Mississippi County does not offer a program in electronics technology. They offer only one course in basic electronics. The course is designed to introduce students to how electronic control devices are analyzed and designed. The course lists General Physics II as a prerequisite. This was consistant with the rest of their program in solar energy. The solar technology courses, six in all, are an option attached to their typical pre-engineering curriculum.

Texas State Technical Institute - Waco, Texas

TSTI has an extensive electronics program consisting of a six quarter program. The institution offers twenty-one courses (mostly 4 qt. hr.). The program starts with a basic D.C. & A.C. course and progresses through fundamentals and application of industrial robots.

Their program in solar energy, as it existed in 1983-84, was an independent program and did not require as a prerequisite any of the courses taught in the electronics program. The electronics components of the program were taught in the various courses. The program was unable to sustain itself and was being revamped.

They have an extensive heating and air conditioning program and are attaching the solar courses as an option to that program.

Navarro College - Corsicana, Texas

Navarro offers an Electronic Technicians program. They offer light (4 to 5 sem. hrs.) courses starting with D.C. & A.C. circuits through microprocessor controlled equipment. Navarro has their solar courses attached to their heating and cooling curriculum. In this program, however, the basic A.C. & D.C. courses are requirements of the first and second semester.

Central Texas College - Killeen, Texas

Central Texas offers two programs in electronics - Communications Electronics Technology and Computer Electronics Technology. They teach 23 courses in the first curriculum and eleven additional courses as options in the later. Their solar technology courses are attached as an option to the air conditioning and refrigeration program. The air conditioning and refrigeration program has two electronics courses listed as the nine possible.

Jordan College - Comstock, Michigan

Jordan College does not have an electronics program on the campus we visited but offer electronics as part of each of the courses in the Renewable Energy Program.

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LABOR MARKET ANALYSIS

This analysis is not intended to be an exhaustive study of the current and potential jobs in alternative energy technologies, energy conservation technologies, and energy management. Such an extensive treatment is beyond the scope of this project. What has been attempted in preparing this study is to review pertinent energy studies, to review current and projected market and job statistics, and to survey Illinois businesses to determine their perceived needs for employees with energy training. From this information, reasonable projections shall be drawn concerning the job opportunities that will be developing the energy related fields. Later in this study, conclusions shall be drawn from this information concerning how the community college system in Illinois can best respond to these developing jobs.

Jobs in alternative energy technology, energy conservation, and energy management are dependent on energy consumers changing the amount of energy they consume, the sources they choose to supply their energy needs, and/or the manner in which they manage their energy use. These types of changes do not come easily for Americans whose institutions, building stock, and lifestyles were molded around the cheap energy available in the 1950's and 1960's. Prior to 1973, most experts predicted that there would be a high demand for more energy every year. Most government planners, energy suppliers, and utilities companies did their planning based on a continuously rapidly inflating demand for energy. "Between 1962 and 1973 the average sale per residential customer (of electric power) grew at between 5.8 and 7.3 percent annually for major Illinois utilities."[2] Then the Arab oil

embargo of 1973 made a dramatic change in the price paid for energy in the United States. Oil prices went up dramatically and with them all other energy prices have gone up and, with the exception of a few minor price dips, have continued to go up. It has been a painful change, but rising costs have forced Americans to change their energy habits. "Since 1974. . . average (electric) use per customer has grown at a much slower pace, increasing at an annual rate of between 1.05 and 3.1 percent. The drop in the rate of increase in consumption per customer implies that, while individual consumers continue to increase electricity consumption, the rate at which their consumption is increasing has slowed."[3]

During the era after 1973, many energy studies and projections were commissioned. In spite of the laborious care taken with many of these studies, most of the studies were not very accurate in predicting current **demand for** electricity or other energy sources, the rate of **implementation** of conservation technologies and alternative energy technologies, the current prices paid for energy, or the number of emerging jobs in the alternative energy technology and energy conservation fields. To cite an example pertinent to this study, in 1978 Navarro College in Corsicana, Texas prepared a report assessing the need for developing skilled worker training for the solar energy industry. In their report they used three major market studies which predicted that at least 2.4 million solar hot water and hot water space heating units would be installed in the United States by 1985. Judging from the number of systems installed by 1983, these predictions will not likely be met.[4] The study was carefully prepared, and the studies

used were by reputable sources; however, there are many intangibles in energy predictions. In 1978 not many people anticipated 15 and 16 percent interest rates on home mortgage loans, 18 and 20 percent interest on business loans, and an extended economic recession.

Judging by the number of experts that have not managed to predict the current energy situation, it is clear that energy predictions are uncertain at best. There are a number of reasons for this. Energy prices are subject to a large number of influences, the more important of which include available supply and reserves, energy subsidies, government policies and regulations, politics, lobbying, wars, and the business decisions of the energy suppliers. The actual market response of energy consumers is subject to yet another set of influences, including lifestyle and habit, consumer perception of the energy situation, the condition of the economy, interest rates for home mortgages, interest rates for business loans, and the rate of return on investment required by business investors. Accurate predictions are difficult ot prepare; this is a clear fact.

This does not change, however, the seriousness of our energy situation. In a recent conference committee, Sen. Birch Bayh (D-Ind) decried the fact that little has been done despite previous warnings on America's energy vulnerability. "Its so easy to forget the gas lines," he said. He compared America's situation to the story of the postman who said "the first bite is the dog's fault, the second is mine." Rep. Cecil Heftel (D-Hawaii) continued the metaphor, this is not the second bite, he said, it is at least the third bite. The White House and Congress seem

"oblivious" to the energy crisis. . . Sen. Dave Durenberger (R-Minn.) said the Reagan Administration is not committed to having an energy policy.[5]

The State of Illinois, however, has some commitment to having an energy policy. The Department of Energy and Natural Resources has taken one of the first steps by investigating a wide range of energy related questions and publishing the facts that are gathered in a six volume set. In the 6th volume of this document, titled the Illinois Energy Plan, the seriousness of the problem is noted. Quoting the just released study "Illinois Resources," the Illinois Department of Energy and Natural Resources Newsletter states ". . . that Illinois energy consumers have responded to energy price increases, resulting in a slowdown of energy consumption growth rates. But the study adds that consumers in all categories have tended to react to energy price increases after the fact even when those increases were predictable. As a consequence, higher prices for natural gas, electricity and oil are projected to outpace the economic benefits earned by the expected modest improvements in energy efficiency as the next century approaches. The resulting drain on the Illinois economy would be devastating. The energy price increases that went into effect between 1972 and 1979 cost Illinois $12 billion in 1979 alone, and future price increases would only worsen the economic loss."[6] There is clearly a need for action on adjusting our energy policies.

In spite of the unreliability of most energy predictions, there are some trends that are fairly certain. One of these is that some of our energy resources will be in shorter supply in

the next few years. It is quite clear that the peak production of oil and natural gas, even considering future explorations, will be reached around the turn of the century (see table 1). This is well documented by many sources. This will have two major effects: first, the costs of these fuels will go up as the supply goes down and second, there will be a substantial amount of fuel switching that will have to take place. Another fact that is quite clear is that the price of all fuels will continue to go up dramatically. This coming cost increase is also well documented. In Illinois and in other states the costs of electricity especially will continue to rise. In addition to the increasing fuel costs for the fuels needed to generate electricity, the reduced rate of growth of peak demand and electricity consumption has caused difficulties and resulting price increases for utilities. According to the Illinois Energy Plan, Volume 1, "most utilities did not anticipate decreases and many utilities did not anticipate decreases and many utilities were faced with a situation in which they had planned and began to install additional generating capacity for a level of demand that didn't materialize according to schedule. Consequently, a number of utilities found themselves trying to pay for extremely expensive construction programs with revenues from sales that were much lower than had been expected."[7]

Three things are clearly going to continue to happen: energy costs will continue to rise, our typical patterns of energy use will be forced to change, and energy consumers will eventually be forced to take action because they will have no other choice--they simply won't be able to afford not to (see tables 2 and 3).

The most difficult question is when will energy consumers change their patterns of energy use? This question is probably not answerable with any degree of accuracy. It is possible, however, to look at the current alternative energy and energy conservation marketplace in Illinois and in other states and to survey the opinions of Illinois businesses.

The current solar market is holding fairly steady through 1982 and 1983 with 16,828,000 square feet of collector manufactered in 1983 (see table 4).[8] Although this was a slight decline in square footage of collectors, some sources claimed that adjusted for inflation, the actual value of collectors shipped went up.[9] A close look at table 4 shows some interesting market changes. The quantities of the concentrating and evacuated tube collectors went down. This reduction of the higher priced collectors may indicate a reduction of government funded projects or perhaps a shift away from the higher priced technologies. The quantities of low temperature collectors also went down. These types of collectors are typically used for swimming pool heating. This may indicate a continued downturn of the economy or simply home-owners buying smaller systems. The quantities of medium temperature collectors were up. These types are typically used for domestic hot water and space heating. The analysis by state in table 5 shows Illinois to be the 12th largest in shipment of collectors of the states reporting..

The photovoltaic manufactures shipped panels totaling 12,620,313 peak watts (Wp) in 1983, which was a substantial increase from the 6,896,998 Wp in 1982.[10] The photovoltaic industry is preidcted to have a strong growth in the coming years. Arco,

a major photovoltaic manufacturer, predicts that the costs curve of the increasing prices of off-the-grid electricity will meet the cost curve of decreasing photovoltaic costs by the early 1990's, making photovoltaic electric systems cost effective in many residential applications. Other experts seem to agree. Paul Maycock of PV Energy Systems, a consulting firm in Alexandria, VA., predicts factory prices of $4/Wp in 1990, and small DC systems with 2 days of storage at $5/Wp in 1990.[11] A recent study by C.S. Borden of Jet Propulsion Laboratory of Pasedena, CA. indicated that photovoltaic systems could be cost effective in some parts of the country if the installed cost could be brought down to $5.46/Wp.[12] According to a report by the Atmospheric Sciences Research Center of the State University of New York at Albany, "the rapid trend in PV(photovoltaic) development and the expectations of PV electricity cost well below 10¢/KW (in 1984 dollars) during the 1990's are acknowledged even by generally conservative organizations such as the Electric Power Institute." Photovoltaic applications are likely to be economical in New York within the next five years, study authors Richard R. Perez, Ron Stewart, and Bruce H. Bailey found.[13]

Energy conservation technologies are often overlooked as an energy source. The implementation of energy conservation technologies and energy management is an important area that has considerable potential for growth. According to the Illinois Energy Plan in the summary of section of Volume 3, "the analysis in this report shows that conservation is the least costly way to meet the growing demand for energy-related services such as warmth, illumination, cooling, process heat, and so on. Since

all the conservation measures which were examined are cost-effective at current and projected energy prices, implementation of the measures would result in energy cost savings which outweigh the cost of the measures themselves." Concerning industrial conservation the report said, "the analysis for this report found that energy use by Illinois' industrial sector in the year 2006 could be reduced by 13 percent, compared with 1980, through investment in technically and economically feasible energy efficiency improvements."

Jobs in energy conservation are so widely spread throughout different trade industries and institutions that job growth in this area is very difficult to track. Due to the tremendous potential in the conservation and energy management areas, this is a likely area where many new jobs will develop. Because energy cost increases impact so many different businesses, industries, and institutions, there are also many opportunities developing for individuals who have skills in energy use assessment and energy management. Individuals who can add these skills to their traditional job skills will have an employment advantage over others who do not.

There are also developing businesses, especially in the more urban areas, which specialize in energy management. These firms contract with larger businesses and institutions to manage their energy use. The firms often charge no "up front" fee for their services but generate their fee and payments on the principal and the interest on the purchase of energy conserving equipment through the energy savings generated by their energy management activities. These types of businesses are likely to become more

numerous. As they grow, it is likely that more businesses and institutions are likely to realize that they can do this type of work "in house" by hiring an individual with energy training or by retraining an existing employee.

Southeastern Illinois College conducted a survey of business and industry in Illinois to determine the current and short term projected labor market need for employees with varying degrees of alternative energy skills and knowledge. The survey involved 200 businesses located in northern, central, and southern Illinois. Counties targeted included Cook, Peoria, Saint Clair, Sangamon, Macon, Wabash, White, and Saline. Forty-five businesses out of the 200 responded to the survey, for a 22.5% total response.

Businesses surveyed were chosen from the 1983 Dunn and Bradstreet Directory of Business and Industry and were restricted to an employment range of 25-249. Types of businesses surveyed included utilities, building trades, heating and air conditioning, electrical, farm construction, sheet metal, insulation, engineering, manufacturing, and institutional facilities. No attempt was made to scale survey responses according to individual business types. Only overall responses are reflected in the following survey results:

BUSINESS AND INDUSTRY QUESTIONNAIRE

Southeastern Illinois College recognizes that rising energy costs are having profound effects on Illinois residents and the state's business and industry community. In response to these effects, the college is exploring better ways to meet the educational needs of residents and the business and industry sector. To help solve our energy problems, we are studying the possibility of establishing a vocational-technical program leading to an associate degree in alternative energy technology. Students would be trained in the various facets of such alternative sources of energy as solar, wind, and biomass. Energy management and conservation would also play an important part in the program. The results of this survey will be used to help determine the need for this type of training.

By answering the following questions, you will help us in our efforts to develop an effective alternative energy technology program. Your assistance will be much appreciated. Please return the questionnaire by Friday, August 24, 1984. A self-adressed, stamped envelope has been enclosed for your convenience.

Check the appropriate answer. If you feel that you cannot answer a question, please leave it blank.

1. Rising energy costs have affected our business.
   ( ) Agree (39) ( ) Disagree (2) ( ) No opinion (2)

2. We have implemented measures to reduce our energy costs through (check all that apply):
   16 ( ) changes in our energy management policy.
   22 ( ) modest investments in energy conservation measures.
   8 ( ) substantial investments in energy conservation measures.
   1 ( ) modest investments in alternative energy systems.
   0 ( ) substantial investments in alternative energy systems.
   1 ( ) other. Please specify:_____

3. We would consider purchasing the following items if they were cost-effective and reliable (check all that you would consider):
   25 ( ) additional insulation.
   29 ( ) more energy-efficient equipment.
   11 ( ) peak load management systems.
   5 ( ) solar space heating systems.
   1 ( ) solar water heating systems.
   3 ( ) wind energy systems.
   2 ( ) photovoltaic (solar electrical generating) systems.
   4 ( ) alcohol-powered vehicles.
   2 ( ) other. Please specify:_____

4. We have done the following (check all that apply):
   3 ( ) hired an outside consultant to prepare an energy audit.
   13 ( ) prepared an energy audit ourselves.
   2 ( ) hired an outside consultant to prepare an energy management plan.
   14 ( ) prepared an energy management plan ourselves.
   19 ( ) none of the above.

5. If classes, workshops, and seminars on saving energy through practicing energy management and conservation techniques and applying cost-effective alternative energy technologies were offered, I would (check all that apply):
   17 ( ) be interested in attending.
   7 ( ) not be interested in attending.
   9 ( ) be interested in sending some of our employees.
   4 ( ) not be interested in sending our employees.
   9 ( ) no opinion.
   3 ( ) other. Please specify:_____

6. If classes, workshops, and seminars focused directly on our business' energy problems and concerns, I would (check all that apply):
18 ( ) be interested in attending.
6 ( ) not be interested in attending.
7 ( ) be interested in sending some of our employees.
7 ( ) not be interested in sending our employees.
9 ( ) no opinion.
2 ( ) other. Please specify:_____

7. I would prefer the following instructional forma:(s) (check all that apply):
2 ( ) on the job training
1 ( ) full-length vocational classes (three, one-hour classes plus lab per week for 16-18 weeks).
4 ( ) five or six short but intensive workshops (2-3 hours in length each).
17 ( ) one-day workshops focusing on different energy related topics.
4 ( ) self-instruction using individualized learning modules.
3 ( ) format does not matter.
9 ( ) no opinion.
0 ( ) other. Please specify:_____

8. If presented with two job applicants with otherwise similar qualifications, but one applicant had attended a number of classes or workshops on saving energy and handling alternative energy systems, we would:
14 ( ) give preference to the applicant with energy training.
2 ( ) not give preference to the applicant with energy training.
16 ( ) weigh other factors unrelated to energy training in choosing one applicant over the other.
5 ( ) no opinion.

9. Our business (check all that apply):
10 ( ) currently employs one or more full-time energy specialists.
1 ( ) is considering hiring one or more full-time energy specialists within the next five years.
7 ( ) would consider hiring one or more full-time energy specialists if they could save our business a significant amount of money by reducing energy costs.
8 ( ) other. Please specify:_____

10. Our business (check all that apply):
3 ( ) currently contracts with one or more outside energy consultants.
1 ( ) is considering contracting with one or more outside energy consultants within the next five years.
7 ( ) would consider contracting with one or more outside energy consultants if they could save our business a significant amount of money by reducing energy costs.
8 ( ) other. Please specify:_____

11. Our business employs the following number of full-time energy specialists:
( ) 0 (27) ( ) 1-5 (9) ( ) 6-10 (2) ( ) 11+ (2)

12. Our business uses the services of the following number of energy consultants:
( ) 0 (31) ( ) 1-5 (8) ( ) 6+

We would like to receive information regarding classes, workshops and seminars on energy conservation, energy management, and alternative energy technologies offered at Southeastern Illinois College. ( ) Yes (23) ( ) No (12)

Comments:_____

_____

_____

THANK YOU!

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Although difficult to quantify, there are clearly jobs opening in the alternative energy technology, energy management, and energy conservation areas. These jobs will be in more diverse areas than was predicted a few years ago. Until recently, the major emphasis on training in the solar energy field in most community colleges and vocational institutions was to train solar collector installers. The jobs in the energy field are currently and will continue to be in much more diversified areas than simply collector installers. Even the task of collector installing requires less specialized training than many people originally supposed. According to the previously cited study at Navarro College, "an analysis of the tasks for design, installation and maintenance for a typical solar system reveals that the solar tasks accounted for approximately 20% of the total task time. The remaining 80% of the tasks could be performed by solar-trained conventional tradesmen--the solar mechanic."[14] Nearly all of the alternative energy education institutions polled that had active programs offering certificates or two-year degrees in alternative energies indicated that they had moved or were moving their curriculums towards providing a more generalized background for their trainees. This was to provide their graduates with wider job choices upon graduation and a better chance at placement in the field.

A number of job areas in the alternative energy technology, energy conservation, and energy management fields look promising. First there will still continue to be jobs in the design, installation, and maintenance of active solar collectors. The

numbers of these jobs will vary considerably in different regions. There is also an emerging market for passive solar water heaters as this technology is rapidly advancing. There is a growing market for passive solar buildings. When the building trades industries begin to move again, there will be a demand for persons with skills in the design and construction of passive solar buildings. There will likely be a need for training and re-training in passive solar construction. The increasing uitility costs will force a market for energy efficient retrofit of existing building stock. These retrofits would include conservation and solar options. Each energy cost increase makes more retrofit options cost effective for exising buildings. Also, the continued high interest rates reduce the numbers of new buildings built, keeping people in older buildings and increasing the motivation to improve the energy efficiency of these buildings. There is a need for energy components to be added to traditional building trades training and a need for retraining programs. There is a current modest job market for persons with energy auditor training.[15] This market will very likely grow in future years. The market for persons with training as an energy management professional for industries and institutions is growing. In some cases this person will be hired as a specialist in larger organizations. Smaller organizations would likely hire someone who had these skills in addition to their other job skills. There is a current and growing job market for installers of electronic energy management devices. Many larger institutions have these devices, and many more will purchase them as utility rates go up. The

number of these devices will also go up as the current trend of utility companies to place smaller users on peak load rate structures expands. There is currently a small market for photovoltaic devices. As this market expands, there will be a need for persons with electronics training to install and service these systems. Most of the alternative technology areas will have a need for sales personnel. A large portion of the current solar job opportunities in Illinois are in the sales area.[16] Many of the companies hiring solar salesmen unfortunately often prefer persons with no prior solar training. Of the sales jobs in alternative technologies, energy conservation, and energy management, the jobs in the sales of energy management devices and energy management services are likely to require the most energy training. There is also likely to be a need for many persons in non-energy areas to have some background in alternative energy, energy management, and energy conservation technologies. This will grow in importance as energy costs go up and these costs impact severely on "business as usual."

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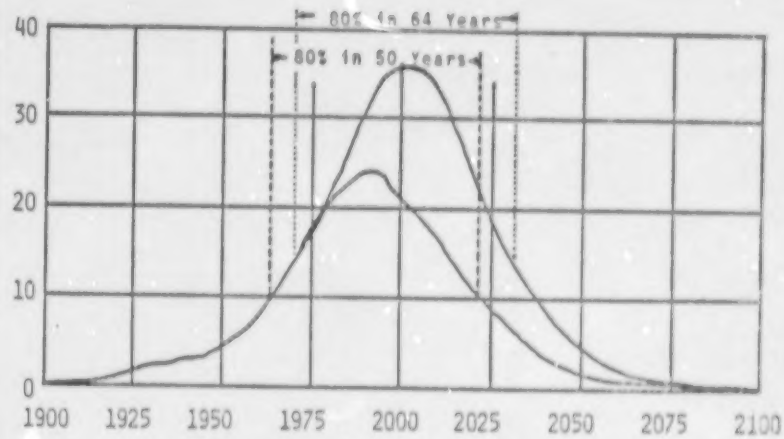
DEPLETION RATES

CYCLE OF WORLD OIL PRODUCTION



PRODUCTION (10^{M} BARRELS PER YEAR)

SOURCE: U.S. BUREAU OF CENSUS AND RESOURCES FOR THE FUTURE

TABLE 1

Table Estimated Household Expenditures for All Energy by Income Class

(1980 Dollars)

	1985			1995		
	Hi	Med	Low	Hi	Med	Low
$0-8,999	1348	1309	1291	1678	1586	1540
$9,000-17,999	1789	1737	1717	2228	2104	2043
$18,000-26,999	2492	2221	2196	2851	2691	2613
$27,000-35,999	2591	2515	2487	3227	3047	2957
$36,000 & Over*	3262	3165	3129	4062	3835	3725

	1990			2000		
	Hi	Med	Low	Hi	Med	Low
$0-8,999	1811	1616	1508	2377	1818	1591
$9,000-17,999	2405	2145	2001	3154	2494	2113
$18,000-26,999	3076	2744	2559	4036	3189	2719
$27,000-35,999	3482	3106	2897	4568	3612	3060
$36,000 & Over*	4236	3909	3647	5750	4546	3850

Source: U.S. Department of Energy.
Illinois Institute of Natural Resources.

TABLE 2

Table Projected Total Energy Bill
Relative to Gross State Product

(Millions 1980 Dollars)

	Projected Illinois GSP	Projected Total Energy	Energy Cost as % of Illinois GSP
1978	$140,758	$17,064.5	12.1%
Low Scenario 2000	$218,839	$35,653.7	16.3%
High Scenario 2000	$218,839	$50,344.5	23.0%

Source: Illinois Institute of Natural Resources.
Illinois Department of Commerce and Community Affairs: Illinois Monthly Economic Data Sheets.
Data Resources, Inc.: Review of the U.S. Economy.

TABLE 3

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Applications According to End-Use
(In square feet)

	1983	1982
Pool heating	4,839,000	7,035,000
Hot water	9,323,000	R7,444,000
Space heating	2,082,000	R2,367,000
Space cooling	25,000	73,000
Industrial	174,000	295,000
Agricultural	106,000	107,000
Other uses	279,000	1,301,000
TOTAL	16,829,000	R18,621,000

Applications According to Market Sector
(In square feet)

	1983	1982
Low-temp, non-metallic	4,336,000	6,669,000
Low-temp, metallic	517,000	807,000
Medium-temp, air	774,000	R1,134,000
Medium-temp, water	10,584,000	R9,357,000
Special, concentrator	435,000	552,000
Special, evacuated tube	78,000	84,000
Other	104,000	R17,000
TOTAL	16,829,000	R18,621,000

Source: Energy Information Administration. R indicates revision.

TABLE 4

STUDENT SURVEY

Southeastern Illinois College (SIC) conducted a survey to determine student interest in enrolling in alternative energy-related workshops, courses, and programs at the college. Of the eighty-five SIC students who were given the survey, 85 responded (refer to page 75 for the areas of study represented by students surveyed).

STUDENT QUESTIONNAIRE

1. Age 25½ average

2. Male 55 Female 30

3. Major (Refer to following page.)

4. Would you be interested in taking a three-hour course that introduced you to the basics of such renewable energy sources as wind, solar, alcohol, and water?

   Yes 46 No 38

5. Would you be interested in taking a three-hour course in energy conservation and management that showed you how to save energy and cut energy costs?

   Yes 48 No 47

6. When would be the most convenient time for you to take these courses:

   Day 20 Evening 40

7. Would you be interested in enrolling in a one-year certificate program in renewable energy technology?

   Yes 27 No 59

8. Would you be interested in enrolling in a two-year A.A.S. degree program in renewable energy technology?

   Yes 20 No 63

9. If you were enrolled in a traditional vocational-technical program (e.g. electronics, business management, building trades, mining, heating and air conditioning) or enrolled in a pre-engineering program, would you be interested in taking three or four renewable energy courses as part of your curriculum to fulfill the requirements for a renewable energy option to your certificate or degree?

   Yes 55 No 19

MAJORS

Accounting	1
ADN	6
Ag Education	2
Business	7
Chemistry	1
Civil Engineering	2
Education	3
Electrical Engineering	2
Engineering	3
Environmental Engineering	1
Law	1
Marketing	1
Math	1
Mining Electricity	1
Mining Engineering	1
Mining Technology	28
Mortuary Science	1
Nuclear Engineering	1
Nursing	5
Pre-engineering	2
Psychology	1
Science	2
Social Services	1
Welding	4
Associate of Arts	1
Undecided	2
No comment	4

CONCLUSIONS AND RECOMMENDATIONS

This section consists of conclusions and recommendations based on information gathered during this study.

It is important to note that energy and energy issues impact many traditional areas of academic study. Ideally these energy topics would be integrated into courses when it became important to understand the impact of changes in our energy use patterns and the impacts of rising energy costs. In many cases this is not possible at this time because when current instructors of these courses were educated these issues were not addressed. With this in mind, it would be wise to offer special workshops and summer credit courses for primary, secondary, and college level instructors. These types of programs have met with some success in this state and in other regions.

Until the time comes when more instructors are able and willing to include energy issues into their traditional courses, there will be a need for energy and alternative energy courses that will act as service courses to other academic areas. A large number of the institutions contacted in this study indicated that many students in other academic areas attended their survey of alternative energy and introduction to solar technologies courses. A number of institutions in Illinois have offered and do offer such courses. These courses should be offered in all higher education institutions. Courses that survey the economic impacts of rising energy costs on businesses, courses that treat the policy impacts of energy policies on our communities, and courses on energy auditing techniques and energy management techniques for managers should also be offered. These are the types of courses that will give the plant managers,

business owners, administrators, and government officials of tomorrow a place to start when they face the energy problems of the next three decades. If these courses are to be added, instructors will need to have training available to them in our higher education institutions. The establishment of these types of courses should be a high priority.

The need for one-year certificate and two-year degree granting programs in alternative energies varies from one region to the next. In those regions where the market activity in solar and alternavive energy is moderate, such as Illinois, it seems that each state or region can support about one program. The density may be somewhat higher in four-year colleges. The alternative energy programs in such institutions are often housed in mechanical or other engineering programs, with students often getting traditional degrees and taking a few courses in the technical aspects of alternative energies. The alternative energy courses in these institutions are often taught by engineering instructors, and if the school experiences a lower enrollment in these classes it is less difficult to manage the shift than if they had a full alternative energies program. Most of the alternative energy programs in community and technical or vocational colleges are modest in size. Many community college alternative energy programs have merged or are considering merging with existing stronger programs. It may be a safer tactic to start alternative energy programs as part of existing programs. Then, as the programs become better known and student demand increases, the program could be expanded and eventually establish its own department. This would be a safer tactic to follow than that followed by some of

the ill-fated programs that started out as independent programs but were heavily grant dependent and folded soon after the grant dollars were lost. There are a number of academic areas under which alternative energy programs could logically be established. The best choice would depend on what departments were strong and interested in working in these areas. The other consideration would be what emphasis for the energy program is desired. There are a number of logical choices. One strong choice is to merge with a business department. This would put the emphasis on energy policy, energy management, and energy auditing. Another choice would be to join with an industrial maintenance program. This would put the emphasis on industrial energy management or on institutional energy management. Another choice would be to work with a construction technology program. This would put the emphasis on energy efficient construction, insulation, conservation, building retrofit, and passive solar design. A fourth choice would be to join with a heating and air-conditioning program. This would put the emphasis on active solar technologies. A fifth choice would be to join with an electronics program. Electronic controls play an important part in solar applications and in sophisticated energy management systems. Electronics and computers also play a vital role in control systems, energy computations, and in simulations and projections. Electronics plays an important role in wind and photovoltaic systems and will be increasingly important as these systems become more common in years to come. In our study of existing alternative energy programs, substantial evidence was found to justify programs with strong alliances between alternative energy programs and any of

the five academic areas listed above.

Programs could be set up so that students could obtain a one-year certificate or a two-year degree in alternative energies or a traditional degree in one of these areas with a concentration in alternative energy technologies. Alternative energy technology programs could start out merged with another program, expand by providing service courses to other areas, and eventually form an independent department. This kind of staged growth that responds to and develops the academic needs of the institution and the students could reduce some of the problems experienced by some of the alternative energy programs that were contacted during this study, while at the same time leave our educational institutions positioned and ready to serve the growing need for energy education.

It is recommended that the energy curriculum for a two-year program be named Developing Energy Technologies. This title was chosen for a number of reasons. The first is that energy conservation should be considered an important energy source. There are many traditional and newly developed energy conservation technologies that can save tremendous amounts of energy. The word alternative, in its current usage, seems to ignore these energy sources, and the use of the word alternative may cause some people such as a plant manager or a maintenance foreman to overlook retraining opportunities in these programs. A program in Developing Energy Technologies would have a strong emphasis on energy conservation technologies, energy management, and energy auditing training. Another good reason for naming the curriculum Developing Energy Technologies is that many new technologies and applications of old technologies are being discovered and used

that do not fit the categories used to describe alternative energies, such as solar, wind, biomass, or geothermal power. There are technologies such as seasonal cold storage using ice ponds and other new technological developments that are rapidly becoming cost-effective in today's environment of increasing energy costs.

The curriculum developed should prepare the student with a good background in the science of energy so that he or she would be well-equipped to solve future energy problems. The experiences cited by instructors working in existing programs indicate that heavily trained specialists such as active solar collector installers are not well-positioned in today's job market. This experience would indicate that students would be better off getting a well-rounded energy background than a one or two-year program that was narrowly focused. There are a number of entry-level jobs in energy auditing, and an effective curriculum would include a course in residential and/or commercial energy auditing. The curriculum should also include study of active solar technologies for water and air heating, passive solar technologies, wind energy, biomass energy, electronic controls, and solar generated electricity. Because many of the graduates of these programs end up working in or managing small businesses, there should be courses available in small business management, bookkeeping, sales, and marketing.

As mentioned in the section on program evaluation, it is advisable to be ready to revise course outlines and curriculum to respond to changes in the job market. This type of frequent revision could be difficult and expensive for community colleges. State Departments of Vocational and Technical Education could aid

community colleges by commissioning new course and curriculum development and distributing these documents to those institutions who are developing programs. They could also commission training for instructors in using these curriculum materials. The rapid changes in the developing energy fields would make it difficult or at least expensive to prepare modularized open-entry open-exit course materials for most energy courses. However, some of the basic fundamentals could possibly benefit from this type of treatment. These topics might include the elementary physics of heat transfer, building heat load calculations, heating duct and blower design, design of piping and pumping systems, elementary electricity as it applies to wind and photovoltaic systems, and digital and analog electronics as applied to solar and energy management controls. Many of these course materials already exist and could be adapted to programs in developing energy technologies. Although courses in developing energy technology programs would need to remain flexible and changeable, there are clearly some core courses that would need to be established. These would be the courses that introduce the basic science and physics of energy and the survey courses that would introduce the technologies and their applications. The courses that were developed from this point would depend on the emphasis of the program.

At Southeastern Illinois College, we propose to start a program in Developing Energy Technologies by merging it with an electronics program. Electronics technologies are a strong growth area that is also experiencing substantial change with the rapid development of computers and other new electronic technologies and electronics. There is also an advantage to merging two areas

that are expected to experience dynamic change in that both programs will have to remain flexible and responsive to market conditions. Also, one area of solar energy technology that is expected to experience dramatic growth in the 1990's is the photovoltaic area. Since this area of solar energy development is concerned with the production and use of electricity, it is a natural partner with a program in electronics.

As a result of the data, conversations, and observations from the institutions we visited, it appears that the interest in developing energies is not sufficient to sustain an independent program. However, we do feel that Southeastern should move in a direction that could eventually result in such a program.

We recommend that Southeastern put in place the first year of an electronics program to see what kind of interest and enrollments would be generated in a second year of electronics. Southeastern could introduce one or two courses in developing energies during the next year. These courses could become a part of a complete program when the time warranted.

An associate degree could be a part of the electronics or business program. The business-energy degree would concentrate on conservation and energy auditing and the electronic-energy program on the technical areas of wind, solar, and biomass.

FOOTNOTES

[1]Charles Orsak, Robert Barnstone, Harold Gibson, Yashvant Jani, and Jeffrey Morehouse, An Assessment of Need for Developing and Implementing Technical and Skilled Worker Training for the Solar Energy Industry, Corsicana, Texas: Navarro College, 1980.

[2]Illinois Department of Energy and Natural Resources, Illinois Energy Plan: An Overview of Trends in the Illinois Electric Utility Industry, Volume I, Springfield: State of Illinois, July 1982.

[3]Illinois Energy Plan, Volume I.

[4]Solar Energy Intelligence Report (SEIR), April 16, 1984, p. 126.

[5]SEIR, May 21, 1984, p. 165.

[6]Illinois Department of Energy and Natural Resources, Illinois Resources, Volume 2, Number 6, June 1984.

[7]Illinois Energy Plan, Volume 1, p.2.

[8]SEIR, May 14, 1984, pp. 155-156.

[9]SEIR, May 28, 1984,

[10]SEIR, May 14, 1984, p. 156.

[11]SEIR, April 2, 1984, p. 110.

[12]SEIR, April 2, 1984, p. 109.

[13]SEIR, May 21, 1984, p. 166.

[14]Center for Neighborhood Technology, Chicago, Illinois, 1984.

[15]Orsak, Barnstone, Gibson, Jani, and Morehouse, Navarro Study.

[16]Telephone interview with Gary Mielke of Illinois Department of Energy and Natural Resources, Chicago, Illinois, June 16, 1984.

EVALUATION TOOL
ON-SITE VISIT NEEDS LIST

Please provide copies of as much of the following information as you have available.

1. College Catalog

2. Specialized Brochures/Publications on Solar and Wind Energy Vo-Tech Programs.

3. Solar and Wind Energy Vo-Tech Program Descriptions. (i.e. purpose, objectives, goals, etc.)

4. Current Solar and Wind Energy Course Objectives, Outlines, and Syllabi.

5. A List of Textbooks and Workbooks Currently Being Used in Solar and Wind Energy Vo-Tech Courses and Labs.

6. One Learning Guide or Module for Each Solar and Wind Energy Vo-Tech Course Designed According to Competency-Based Instruction.

7. A List of Suggested Elective Courses for Solar and Wind Energy Vo-Tech Programs (if not already identified in college catalog).

8. Number of Personnel Required to Implement Solar and Wind Energy Vo-Tech Programs:

	SOLAR	WIND
Administrators	_____	_____
Faculty	_____	_____
Technical Support	_____	_____
Secretarial	_____	_____
Student Support	_____	_____
Other	_____	_____

9. Estimated Start-Up Cost (Today's Cost) for Solar and Wind Energy Vo-Tech Programs:

Solar $_____ Wind $_____

10. Estimated Annual Cost of Maintaining Solar and Wind Energy Vo-Tech Programs:

Solar $_____ Wind $_____

APPENDIX A

11. A List of the Major Instructional Equipment and Materials Used in Solar and Wind Energy Vo-Tech Programs.

12. A List of Major Laboratory Equipment, Instrumentation, and Materials Used in Solar and Wind Energy Vo-Tech Programs.

13. Special Pretests or Aptitude Tests Administered to Solar and Wind Energy Vo-Tech Students.

14. Results of Any Surveys or Studies Dealing With Solar and Wind Energy Vo-Tech Programs.

15. Data and Information Pertaining to Job Placement and Employment Potential of Solar and Wind Energy Vo-Tech Graduates (e.g. percentage of graduates placed in solar and wind energy-related jobs, types of occupations in which graduates are placed, level of demand from business and industry for graduates, etc.)

16. A Brief Description of Cooperative Arrangements Between the College's Solar and Wind Energy Vo-Tech Programs and Outside Business and Industry to Provide Internships or Practicums for Students.

17. A List of Solar and Wind Energy Workshops and Seminars (credit bearing or non-credit bearing) Offered in Addition to the Vocational Certificate and Degree Programs in Solar and Wind Energy Technology.

18. Summaries of Past and Current Research and Development Activities in Solar and Wind Energy Technologies.

19. A Percentage Breakdown of Funds Used to Support Solar and Wind Energy Vo-Tech Programs:

Student Tuition	_____%
Local, State, and Federal Taxes	_____%
State Grants	_____%
Federal Grants	_____%
Private Grants	_____%
College Foundation	_____%

20. Do the Solar and Wind Energy Vo-Tech Programs Have Advisory Councils? ____Yes ____No

Advisory council members represent what kinds of occupational or professional disciplines:

21. A List of Major Funding Sources:

    1.
    2.
    3.
    4.
    5.

22. List or provide a brief description of your institution's recruitment and public relations activities designed to boost enrollment in alternative energy workshops, courses, and programs.

23. Do you require your VO-TECH faculty to undergo in-service or staff development training on a yearly basis? If so, how many hours are required per year?

TELEPHONE SURVEY OF ALTERNATIVE ENERGY AND ENERGY CONSERVATION PROGRAMS FOR SOUTHEASTERN ILLINOIS COLLEGE

NAME OF INSTITUTION

ADDRESS

CONTACT PERSON

TYPE OF PROGRAM(S) AND PROGRAM EMPHASIS

DO YOU HAVE AN ENERGY MANAGEMENT TRAINING PROGRAM OR SEE A JOB MARKET NEED FOR SUCH PROGRAMS

TYPE OF DEGREES AND CERTIFICATES WHICH YOU OFFER

STATUS OF PROGRAMS

FTE 83-84_____82-83_____
PTE 83-84_____82-83_____

NO. OF YEARS PROGRAM(S) HAVE RUN_____

PROJECTIONS FOR THE PROGRAM FOR THE NEXT FEW YEARS

CURRENT NO. OF FACULTY_____

DO YOU ANTICIPATE HIRING ANY INSTRUCTORS IN THE NEXT FEW YEARS?

EDUCATIONAL CREDENTIALS REQUIRED OF INSTRUCTORS

TOTAL NO. STUDENTS GRADUATED FROM YOUR PROGRAMS_____

% OF YOUR GRADUATES PLACED IN THE FIELD_____

GENERAL COMMENTS ON THE FUTURE OF ENERGY CONSERVATION AND ALTERNATIVE ENERGY PROGRAMS

DO YOU KNOW OF OTHER INSTITUTIONS WITH ACTIVE PROGRAMS THAT WE COULD CONTACT

SOLAR MANPOWER ASSESSMENT

What is the demand for trained solar workers in the United States?

If workers are to be trained in solar energy, what skills must they learn?

The January 1978, Navarro College completed a study for the Department of Energy (DOE) which identified the skills required of solar workers and determined the quantitative demand for these workers on a national scale.

The project had several conclusions:

1) solar workers can be categorized into two distinct classes--solar technicians and solar installer/mechanics,
2) the manpower forecast for the solar field is a direct function of the demand for solar equipment,
3) by 1985 there will be a need for 25,000 skilled solar workers to meet the market demand for solar equipment in the United States.

SKILLS REQUIRED

The study defined the solar installer/mechanic as a conventional tradesman with knowledge of solar systems who is expected to perform entry level tasks of installation and routine maintenance. The solar technician has knowledge and skills specific to solar system design, installation, and diagnostic troubleshooting.

Analyzing all the tasks required to design, install, and maintain a typical solar energy system, solar tasks account for approximately 20% of the total task time. The remaining 80% of the tasks can be attributed to conventional skills.

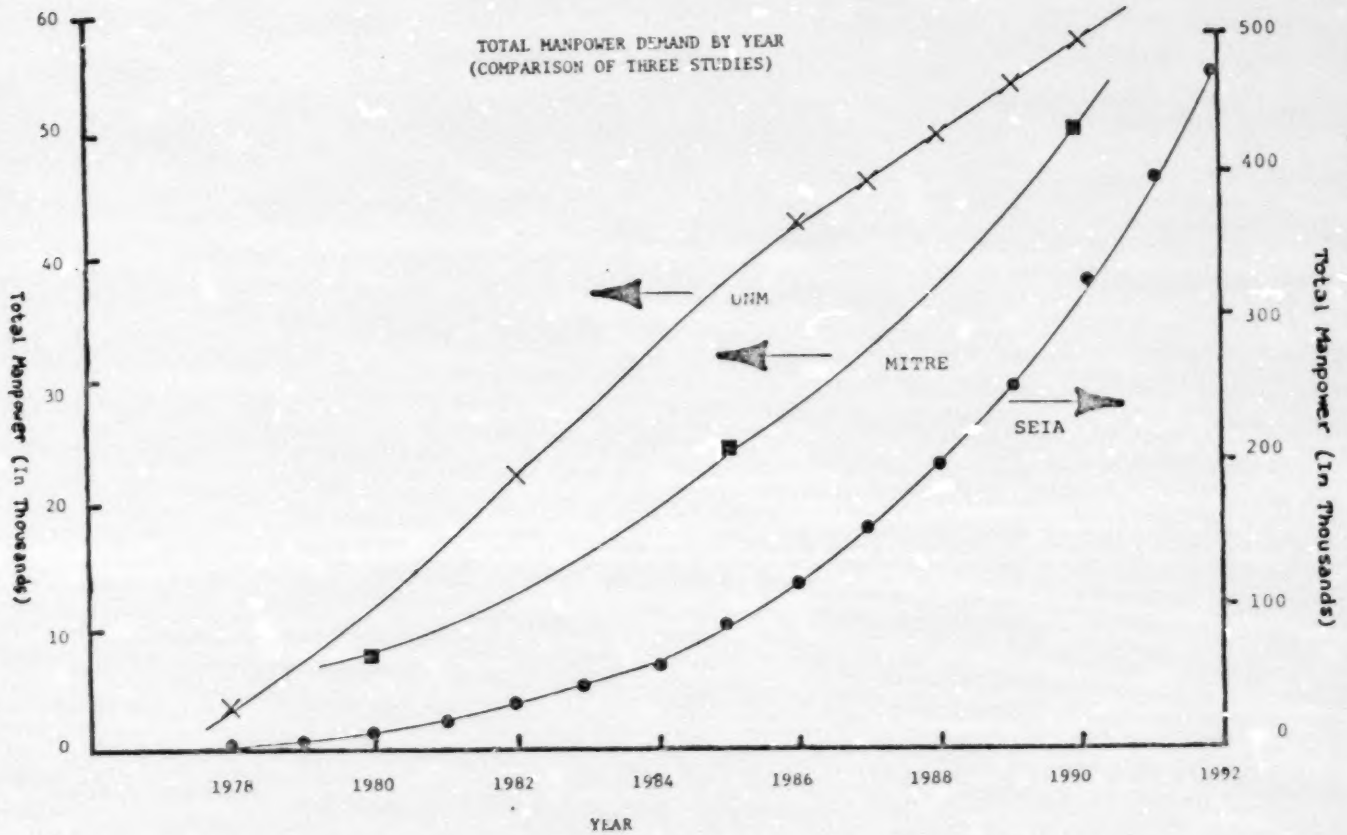
Work Performed for the Department of Energy
under Contract No. EG-77-S-04-3869

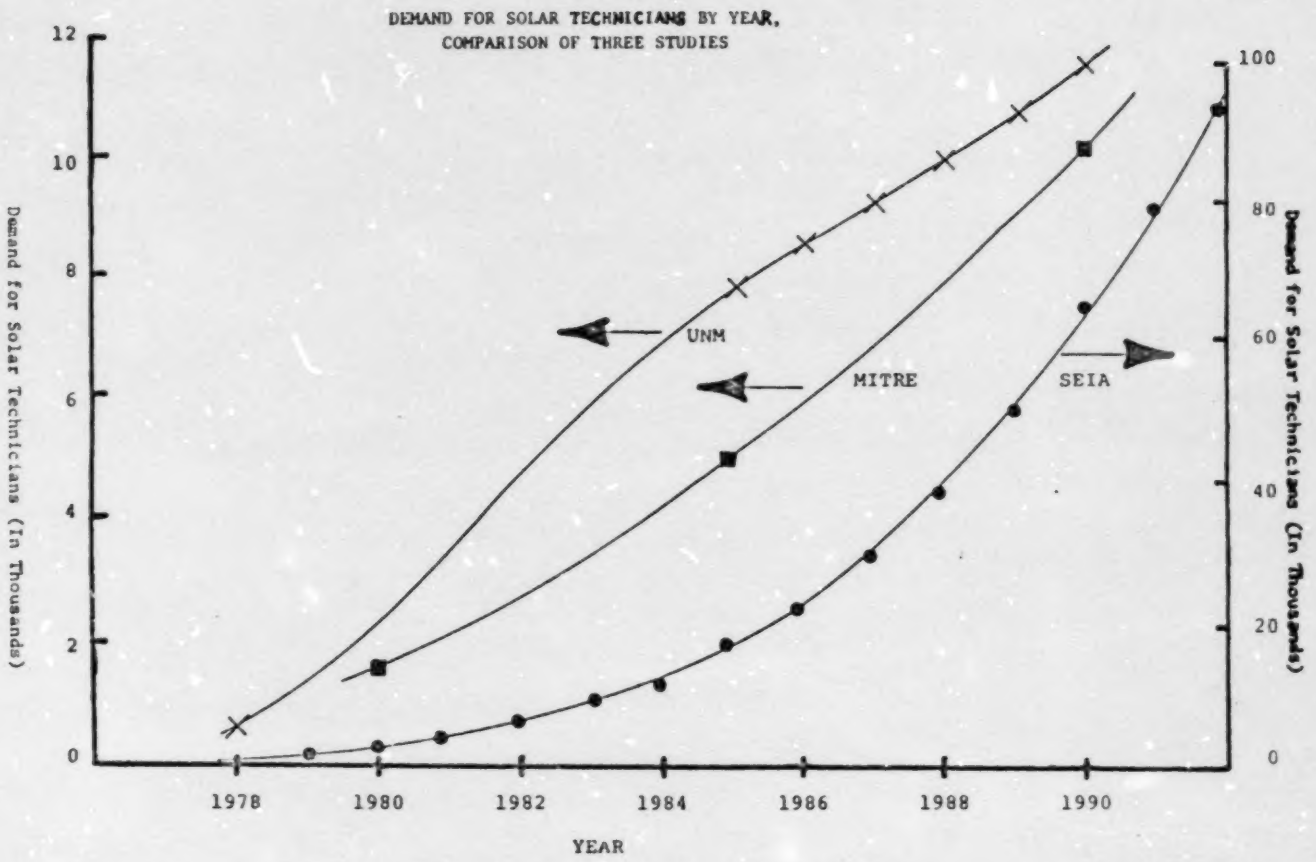
MANPOWER DEMAND

The demand for skilled workers will develop concurrently with the demand for solar equipment. The three solar market projections used in the study (the MITRE, University of New Mexico, SEIA) indicate at least 2.4 million solar installations by 1985.

SOLAR ENERGY SYSTEM REQUIRED SKILLS	
solar	20%
HVAC	5-6%
Plumbing/ sheet metal	55%
electrical	4-5%
carpentry	1%
other	10%

The SEIA study projects a manpower demand of 80,000 solar workers by 1985. Using the UNM study, 40,000 workers will be needed by 1985. Using the MITRE study 25,000 people will be working in solar in 1985. By 1990, the demand increases to 50,000 workers, using the MITRE and UNM studies, and to 325,000 by 1990, according to the SEIA data.





Since 20% of the tasks performed on solar systems are at the technician **level**, the demand for solar technicians will comprise approximately one-fifth of the total manpower requirements: at least 5,000 in 1985, and nearly 10,000 in 1990.

To meet **the demand** for solar **workers**, approximately 80 schools, **each** graduating 50 solar technicians per year, will be needed **between** the present and 1985. To fill the yearly demand for technicians between 1985 and 1990, 40 additional schools will be required. The regional development of these schools should follow the regional demand for installations:

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